A TREATISE OF Practical Gauging:

SHEWING

A Compendious and Easie Way

To attain that

Useful A R T.

The whole Grounded upon the Un-Erring Principles of

GEOMETRY.

By *Marmaduke Hodgeson.*

Quam scit quisque, libens, censebo, exerceat Artem.
Hor. lib. 1. Ep. XIV.

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TO

Mr. *PEREGRINE CONY*,

FELLOW

OF

EMANUEL COLLEDGE

IN

CAMBRIDGE,

AS

An Acknowledgment of former

Kindneſſes this Treatiſe is Humbly

DEDICATED.

THE PREFACE TO THE READER.

Courteous Reader,

I Preſent to thy View and Conſideration a Treatiſe, the bulk only conſidered narrow and ſcanty, but if the extent and choiceneſs of the matter therein contain'd and handled be ſeriouſly weigh'd, large and voluminous enough.

nough. Would the room allotted for this Preamble permit it I might eaſily extend my diſcourſe to a tedious length, and almoſt tire the Peruſer thereof; I could fetch its Pedigree from the days of the Patriarch Abraham, *I could alſo affirm that* Moſes *himſelf amongſt other his accompliſhments attained at the* Egyptian *Court was eminently skill'd therein: I could go on and tell the Reader, that the* Ptolome's *who for ſeveral years ſwayed the Scepter of that Kingdom were great Favourers and Encouragers of that ſort of Learning, of which thoſe many and excellent Volumns ſtow'd in the* Alexandrian *Library, had not the Flames deſtroyed them, would have been a ſufficient proof: I could alſo mention divers Potentates and great Men of later Ages, who were either*

Fruſta's of Elliptick Cones are the ſame, and are Treble of the Diviſors for Cylinders. The Diviſors for Conoids and Fruſta's of Conoids, whether Parabolick Conoids and their Fruſta's, or Conoids having Elliptical Baſes and their Fruſta's, are the ſame, and are Double of the Diviſors for Cylinders. The Diviſors for Globes and Spheroids are the ſame, and are $1\frac{1}{2}$ of the Diviſors for Cylinders. The Diviſors for Fruſta's of Globes are Sextuple of the Diviſors for Cylinders.

Thus much we thought meet to acquaint thee with Gentle Reader. What we have to ſay beſides, is, that the Reviſors overſights crave thy Excuſe and Pardon. It fares with Books as with Men,

Men, falſe Prints ever accompany the former, and frailty the latter. Notwithſtanding thus much we may reaſonably hope for, that if the Readers Diſcretion and Sagacity help him to diſcry a Typographical miſtake, at the ſame time his Candor and good nature will prompt him with his Pen to amend the ſame. So leaving the Reader to the peruſal of the Treatiſe before him, which I hope will in ſome Meaſure anſwer his Expectation, I am and will be to the utmoſt of my Ability a hearty Friend to the Publick Weal.

M. H.

DECIMAL Arithmetick.

THE Fractions in this Arithmetick encreaſe by Tens towards an Unit, as do the whole Numbers in Vulgar Arithmetick from an Unit: For an Unit or (1.) is divided into Ten equal parts call'd Primes or Tenths, every Prime is ſub-divided into ten equal parts call'd Seconds or hundredth parts; and every Second into ten Thirds or Thouſandth parts, *&c.* The denominators therefore of all Decimal Fractions will be 10, 100, 1000, 10000, *&c.* Theſe Denominators are rarely expreſſed, but underſtood.

The whole Numbers are ſeparated from the Decimals uſually by a Comma, as 75,36. to be Read 75 whole Numbers, 3 primes, 6 ſeconds, or 36 hundredth parts.

Addition and *Subtraction.*

SET whole Numbers under whole Numbers, primes under primes, ſeconds under ſeconds, thirds under thirds, *&c.* Then Add or Subtract as if all were whole Numbers.

Examples of Addition.

Add 6.5 | 98.37 | 62.589 | 7.04 | 0.0087 | into 1 ſum.

	6.5
	98.37
	62.589
	7.04
	0.0007
Sum	174.4997

Examples of Subtraction.

From 8.97. Take 3.4.

	8.97
	3.4
Reſts	5.57

From 25.3. Take 2.87.

	25.3
	2.87
Reſts	22.43

Mul-

Multiplication of Decimals.

MUltiply Integers and Decimals together as if all were Integers; and cut off as many places from the product towards your Right hand for Decimals, as is the Number of Decimal places in both Multiplicand and Multiplier.

Examples of Multiplication.

A Back or Tun, Length 81.3 *inch.* Breadth 34.7 *inch.* I would know the Area in Inches?

Multiply the length by the breadth, gives the Area of any Oblong or ſquare.

inch.
81.3
34.7

5691
3252
2439

Area 2821.11

A Triangle whoſe Baſe is 97.6. Perpendicular 54.5. I would know the Area?

Multiply the Baſe by the perpendicular and the half of the product will be the Area of any Triangle.

97.6
54.5

4880
3904
4880

5319.20

Area 2659.60

If you have a Back conſiſting of many Triangles, (after you have drawn Diagonal lines from Angle to Angle, and Obſerved, that the Triangles are leſs by two, and the Diagonals leſs by three, then the Number of ſides in the Perimeter of the Figure) the ſum of all the Triangles will be the Area of the ſaid Back.

If the Diameter of a Circle be (1). we take the Circumference to be 3.14159.

Multiply half the Circumference by half the Diameter, produceth the Area of any Circle.

1.570795 half the Circumference.
0.5 half the Diameter.

.7853975 Area of the Circle.

Now if the Square of any Circles Diameter be Multiplied by .7853975 we have the Area.

A Circle whoſe Diameter is 34 inches, 7 primes. I would know the Area?

34.7

```
  34.7
  34.7
 ------
  2429
  1388
  1041
 ------
1204.09 Square of the Diameter.
  .7854
 ------
  481636
  602045
  963272
  842863
 ------
945.692286 Area of the Circle.
 ------
```

An Ellipſis whoſe Tranſverſe or longeſt Diameter is 81 Inches, 7 primes; conjugate or ſhorteſt Diameter is 41 inches, 3 primes. I would know the Area?

Multiply the Rectangle or product of the Diameters, by .7853975, and you have the Area of any Ellipſis.

```
  81.7
  41.3
 ------
  2451
  817
  3268
 ------
  3374.21
   .7854
 ------
  1349684
  1687105
  2699368
  2361947
 ------
2651010453 4 Area of the Ellipſis.
 ------
```

A Cir-

A Circle whoſe Diameter is 67 inches, 4 primes. I would know the Circumference?

Multiply 3.14159 by the Diameter of a Circle, and you have the Circumference of the ſaid Circle.

3.14159
67.4

1256636
2199113
1884954

211|743166 is the Circumfer.

A Circle whoſe Circumference is 137 inches, 5 primes. I would know the Diameter?

Multiply 0.3183 by the Circumference of a Circle, and you have the Diameter.

0.3183
137.5

15915
22281
9549
3183

Diameter 43|76625

Divi-

Diviſion of Decimals.

DIvide Integers and Decimals together as if all were Integers: Then to know of what Name the firſt figure in the Quotient will be; Obſerve in what place of the dividend the Units place in the diviſor will be found: of the ſame Name will be the firſt figure in the Quotient, whether whole Number or Decimal.

Divide (1.) by 282 the inches in a Beer or Ale Gallon.

282) 1.000 (.003546 Decimal Multiplicator for
1540 Cubes or Parallelepipedons
1300 in Beer Gallons.
1720
28

Divide 1 by 231 the inches in a Wine gallon.

231) 1.000 (.004329 Decimal Multiplicator for
760 Cubes or Parallelepipedons
670 in Wine gallons.
280
001

Divide 282 the inches in a Beer gallon, by .7854 the Area of a Circle within when the Area of the Square without is (1.)

.7854) 28200 (359. Diviſor for Cylinders in Beer
46380 gallons.
71100
414

Di-

Divide 231 the inches in a Wine gallon, by .7854.

.7854) 23100 (294. Diviſor for Cylinders in Wine
73920 gallons.
32340

924

Divide (1) by 359 the Beer Diviſor of Cylinders.

359) 1.000 (.002785 Decimal Multiplicator for Cy-
2820 linders in Beer gallon.
3070
1980

185

Divide (1.) by 294 the Wine Diviſor for Cylinders.

294) 1.000 (0.003401 Decimal Multiplicator for
1180 Cylinders in Wine gall.
0400

106

Divide (1.) by 3.14159.

3.14159) 1.000000 (.3183. A Multiplicator to find
575230 the Diameter by hav-
2610710 ing the Circumfer.
974380

31903

DEFI.

Figure 1.

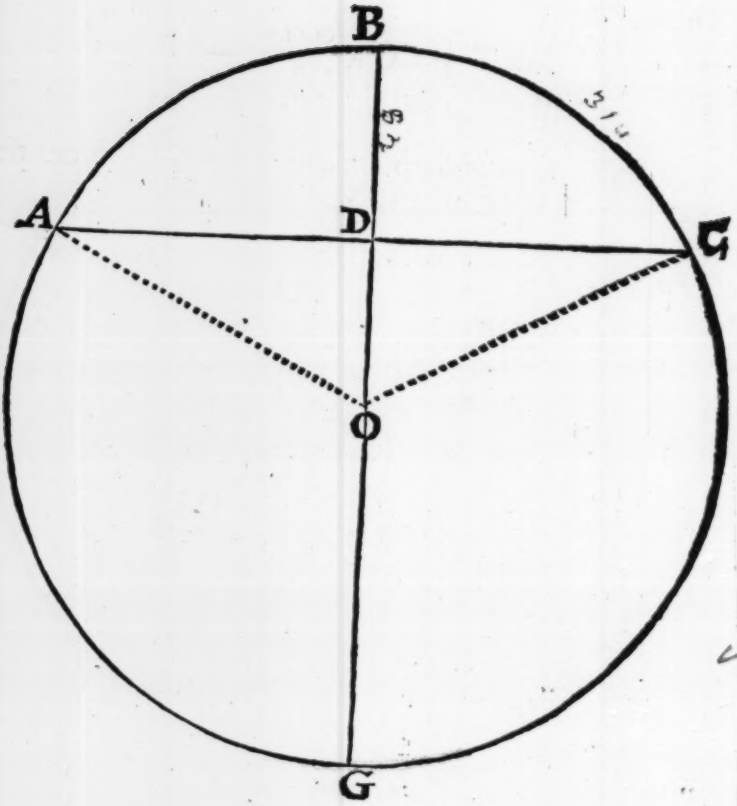
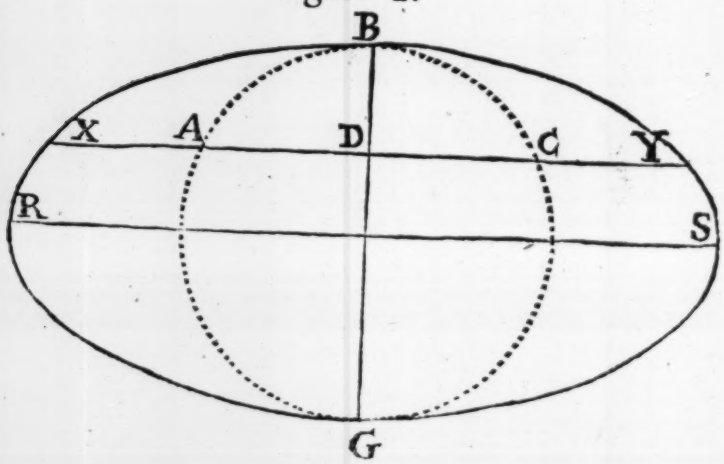


Figure 2.



To find the Area of the Segment of a Circle (ABCD) ; *by having the Diameter* (BG,) *and* (BD) *the Verſed Sine given.*

Figure 1.

LEt (BG) be 314, (BD) 82, I would know the Segment (ABCD.)

From the Centre (O) draw (OA), OC) : the half of (BG) will be (AO), BO,) or (CO ;) the Radius or Semi-Diameter.

From the Radius ſubtract (BD), the remainder will be (DO.)

314 diameter (BG).

half is 157 Radius or (OC.)
Take (BD) 82

Reſts (DO) 75

To the Sine of 90.00 ——— 10.00000
Add the Logarithm of (DO) 75. ——— 1.87506

Sum 11.87506

Take the Log. of (OC) the Radius of Circle 2.19590

	D.	
Reſt Sine Compl. of Angle (BOC)	61.28	9.67916
	D.	D.
Which doubled gives Angle (AOC)	122.56	or 122.93,

The Area of the whole Circle as in Multiplication of Decimals will be 77437, which Multiplied by the Angle (AOC) 122.93, the Product is 9519330, this laſt divided always by 360 Degrees, the Quotient is 26442.5 the Area of the Sector (AOCB): From (BG) 314, ſubtract (BD) 82, the Remainder is (DG) 232; which multiply by (BD) 82, Produceth 19024, whoſe ſquare Root is (AD) or (DC) 137.9; Which multiplied by (DO) 75 produceth the Area of Triangle (AOC) 10342.5, which ſubtracted from the Area of Sector (AOCB) 26442.5, leaves the Area of Segment (ADCB) 16100.

The Rule of Three.

Multiply your ſecond and third Numbers together as in Multiplication of Decimals; divide the product by your firſt Number, as in Diviſion of Decimals; and the Quotient Anſwers.

Example 1. Fig. 2.

Suppoſe an Ellipſe whoſe Tranſverſe diameter (RS) is 78.3, and Conjugate diameter (BG) 31.4. Now if a Line (XY) be drawn parallel to the Tranſverſe diameter (RS), and (BD) the verſed Sine of Ellipſis Segment 82. be given, I would know the Area of Ellipſis Segment (BXDY)?

Let a Circle (BAGC) be inſcribed in the Ellipſis; then 'twill be as (BG) (Conjugate diameter of the Ellipſis), To (RS) (Tranſverſe diameter of the ſame): So is Area of Circles ſegment (BADC), to Area of Ellipſis ſegment (BXDY).

By

By the preceding, the Area of Circles ſegment will be 161 inches.

Inch. Inch. Inch.
As 31.4, to 78.3; ſo 161.0 Area of Circles ſegment,

161.0
78.3
4830
12880
11270

31.4) 12606.30 (401.4 Area of Ellipſis ſegment.
0463
1490
234

Figure 3.

To find the Area of an Ellipſis Segment cut Parallel to the Conjugate Diameter.

Admit BG the Tranſverſe diameter of an Ellipſis be 314, and (RS) Conjugate diameter 121.7: and if (XY) be drawn parallel to (RS), and (BD) 82 the verſed ſine be given; I would know the Area of the Ellipſis's ſegment (BXDY)?

Let a Circle as (BAGC) Circumſcribe the Ellipſis (BRGS): Then 'twill be as (BG) to (RS); ſo is (BADC) (the Circles ſegment), to (BXDY) (the Ellipſis's ſegment). Segment of Circle (BADC) is 16100.

inch. inch.
As 314, to 121.7 ; ſo 16100 Circles ſegment.

16100
121.7
1127
161
322
161
314) 1959370.0 (6240.0 Area of Ellipſis ſegment.
753
1257
0100

To find the Area of a Parabola. Fig. 4.

Multiply (BC) the Axe by (AD) the double Ordinate: Then ſay as (3), to (2); ſo is the ſaid Rectangle, to the Area of Parabola.

A Parabola (AD) the double Ordinate is 81.7, (BC) the Axe is 94.3. I would know the Area of Parabola (ABDC)?

94.3
81.7
6601
943
7544
As 3 to 2 : So 770431
2
3) 1540862 (5136.20 Area of Parabola.
04
10
18
06
02
(0)

To

Figure 3.

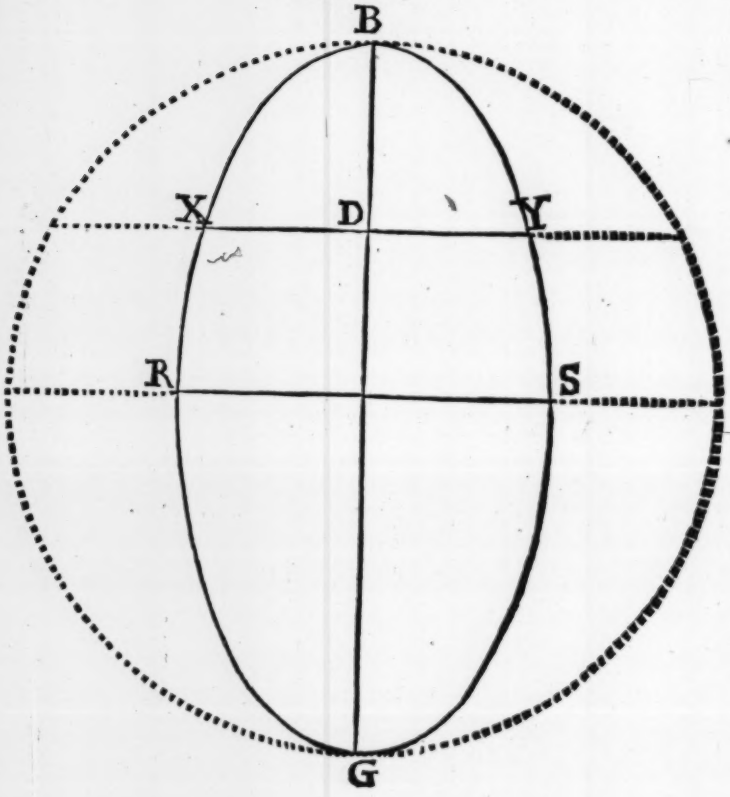


Figure 4.

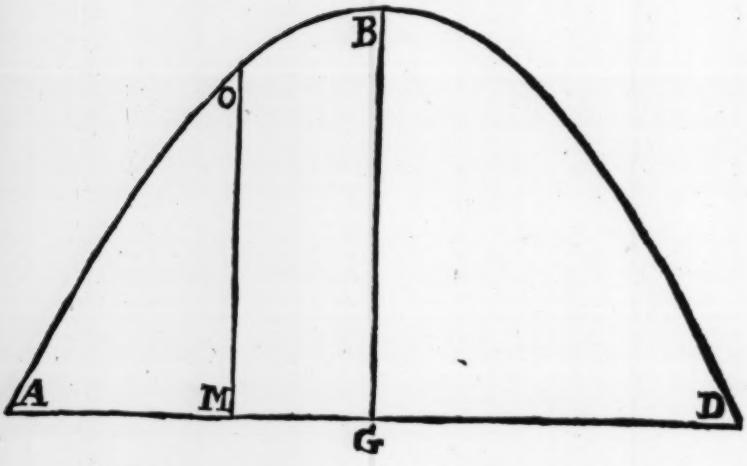


Figure 4.

To find the Area (AMO) *of the Segment of a Parabola cut parallel to the Axe: By having* (AD) *the double Ordinate below,* (BC) *the Axe, and* (AM) *the distance from the extremity of the Curve.*

Let the Axe (BC) be 94.3, (AD) 81.7, (AM) 31 inch. I would know the Area (AMO)?

From (6) times (AD), subtract (4) times (AM). Multiply the remainder by (BC); Then as thrice the square of (AD), to the last product; so is the square of (AM) to the Area (AMO.)

	81.7
	6
From (6) (AD)	490.2
Take (4) (AM)	124.0
Rests	366.2
	94.3
	10986
	14648
	32958
Product	34532.66

81.7

81.7
81.7

5719
817
6536

6674.89
3

20024.67 thrice the ſquare of (AD.)

31
31

31
93

961

As 20024.67 34532.66
961

3453266
20719596
31079394

20024.67) 331 85886.26 (1657 Area of Segment
13161216 of Parabola (AMO.)
11464142
14518076

500|807

D E F I-

DEFINITIONS.

(1.) A Cube, is a Solid contain'd under ſix equal Squares.

(2.) A Parallelepipedon, is that whoſe oppoſite ſides are Parallel and Equal.

(3.) A Cylinder, is that whoſe Diameters are all Equal, and is made by the Rotation of a Rectangled Parallelogram about one ſide remaining fixed till it end where it began.

(4.) A Cone, is made by the Rotation of a Right Angled Triangle about its perpendicular (remaining fixed) till it end where it began.

(5.) A Square Pyramid, from a Square at Baſe, haſtens to a Point or Vertex: Now a Right Line every where applied from the Vertex to the limits of the Square at bottom will touch the ſuperficies of this Pyramid.

A Parallelepipedon having a ſquare baſe and height infinitely ſmall, I call a ſquare.

A Cylinder whoſe height is infinitely ſmall, I call a Circle.

(6.) A Parabolick Pyramidoid is made of an infinite Number of ſquares whoſe Areas are in Arithmetick Progreſſion.

(7.) A Parabolick Conoid is made up of an infinite Number of Circles, whoſe Area's are in Arithmetic Progreſſion, and is made by the Rotation of a Semi-Parabola about its Ax, remaining fix'd till it end where it began.

(8.) An Hyperbolick Conoid is made by the Rotation of a Semi-Hyperbole about its Ax remaining fixed till it end where it began.

(9.) A Globe is made by the Rotation of a Semi-circle about its Ax remaining fixed till it end where it began.

(10.) A Spheroid is made by the Rotation of a Semi-Ellipſe about its Ax, remaining fixed till it end where it began.

(11.) If

(11.) If the ſquare Pyramid in definition 5th. be cut off by a plain parallel to the Baſe, it makes the Fruſtum of a ſquare Pyramid.

(12.) If the Parabolick Pyramidoid in definition 6th. is cut off by a Plain Parallel to the Baſe, that below is the Fruſtum of a Parabolic Pyramidoid.

(13.) If a Cone in definition 4th. is cut off by a plain parallel to the Baſe, what remains below is the Fruſtum of a Cone.

(14.) If a Parabolick Conoid in definition 7th. be cut off by a plain parallel to the Baſe, that which remains below is the Fruſtum of a Parabolick Conoid.

(15.) If a Globe in definition 9th. be any wiſe cut off, and the plain be a Circle, the leaſt part I call the Fruſtum of a Globe.

(16.) An Elliptick Cone from an Ellipſis at Baſe haſtens to the Top and a Right Line every where applyed from the Vertex to the Curve of the Ellipſe below will touch the Surface of the Elliptic Cone: And the Fruſtum is made by a Section cut Parallel to the Baſe.

(17.) If a Spheroid in definition 10th. be cut off by two plains Perpendiculars to the Ax, and equi-diſtant from the Poles, the middle remainder is call'd the Middle Fruſtum of a Spheroid, and repreſents a Cask.

(18) If a Parabola is turned about its double ordinate remaining fixed till it end where it began, the ſolid is called a Parabolick Spindle. If this be cut off by two plains perpendicular to this Ax and equi-diſtant from the poles the Middle Fruſtum repreſents a Cask.

GAUG-

GAUGING.

Problem 1.

To find the Content of a Cube or Dye.

MUltiply the ſide of the Cube by its ſelf and multiply the Product again by the ſide of the Cube. Then,

Divide by {282 / 231} Inch. in a {Beer / Wine} gall. for {Beer / Wine} Gall.

O R,

Multiply by {.0035461 / .004329} for {Beer / Wine} Gallons.

Example.

A Cube each side is 78 inches. I would know the Solid Content in Beer and Wine gallons?

```
        . . . .
282) 474552 (1682 Beer gallons.
     1925
      2335
        792
      ----
        228
      ----

        78
        78
      ----
       624
      546
      ----
      6084
        78
      ----
     48672
    42588
    ------
    474552 Content in Cubick inches.
    ------

        474552
        ·003546
      ---------
        2847312
       1898208
      2372760
     1423656
    ----------
Beer gallons 1682|761392
    ----------
```

231)

231) 474552 (2054 Wine gallons.
1255
1002
78

474552
·004329
4270968
949104
1423656
1898208
Wine gallons 2054|335608

Problem 2.

To find the Content of a Parallelepipedon representing a common Fir-Box.

Multiply the Length by the Breadth, and that product Multiply by the Depth. Then

Divide by {282 / 231} for {Beer / Wine} gallons.

O R,

Multiply by {·0035461 / ·004329} for {Beer / Wine} gallons.

Examples.

inch.

A Parallelepipedon { Length 113, Breadth 78, Depth 13 } I would know the Content in Beer and Wine gallons.

113
78

904
791

8814
13

26442
8814

114582 Content in inch.

282) 114582 (406 Beer gallons.
1782

90

114582
.003546

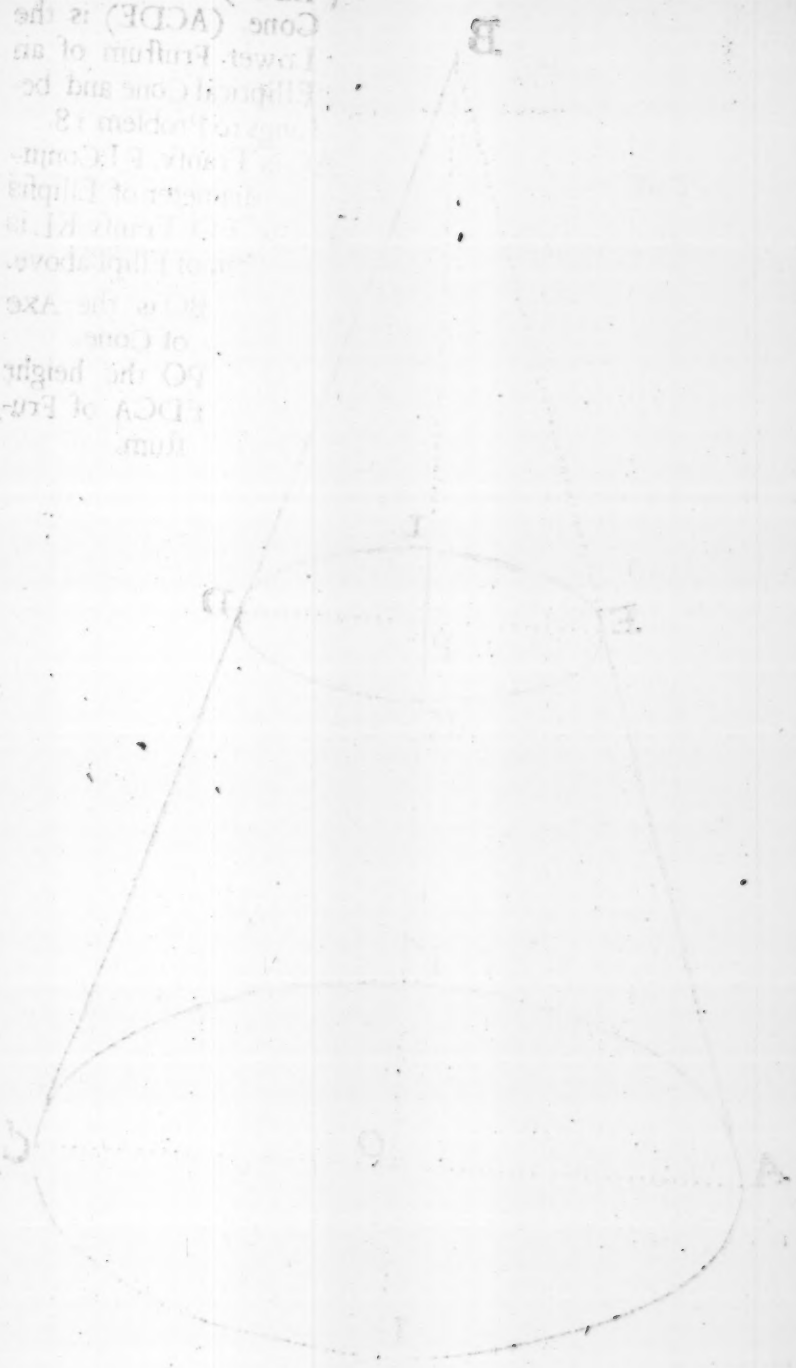
687492
458328
572910
343746

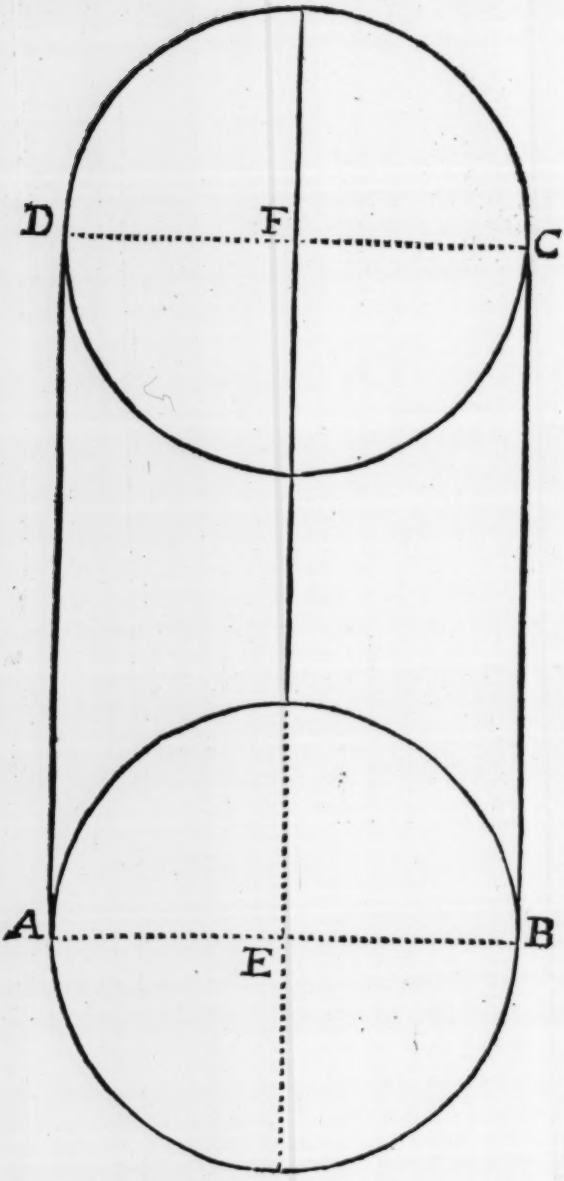
Beer gallons 406|307772

231) 114582 (496 Wine gallons.
2218
1392

06

114582


B
C
A



(ABCD) is a Cylinder and belongs to Prob. 3. the Altitude is (EF) and Diameter is (AB) or (DC.)

114582
.004329

1031238
229164
343746
458328

Wine gallons 4961025478

Problem 3.

To find the Content of a Cylinder repreſenting the Rolling Stone of a Garden.

Square the Diameter (or multiply it by it ſelf,) multiply the Product by the Height. Then

Divide by {359 / 294} for {Beer / Wine} gallons.

O R,

Multiply by {.002785 / .0034} for {Beer / Wine} gallons.

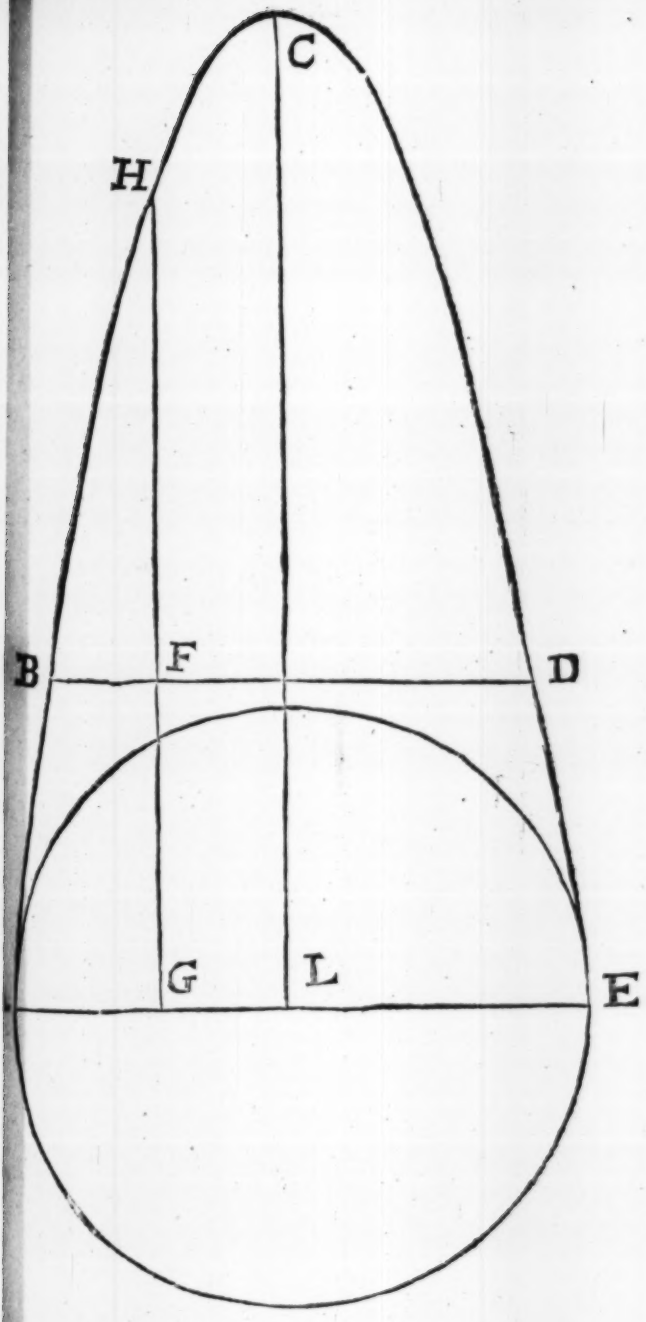
Exam-

Example.

A Cylinder whose Diameter is 76 inches and Depth 51 inches, I would know the Content in Beer and Wine Gallons?

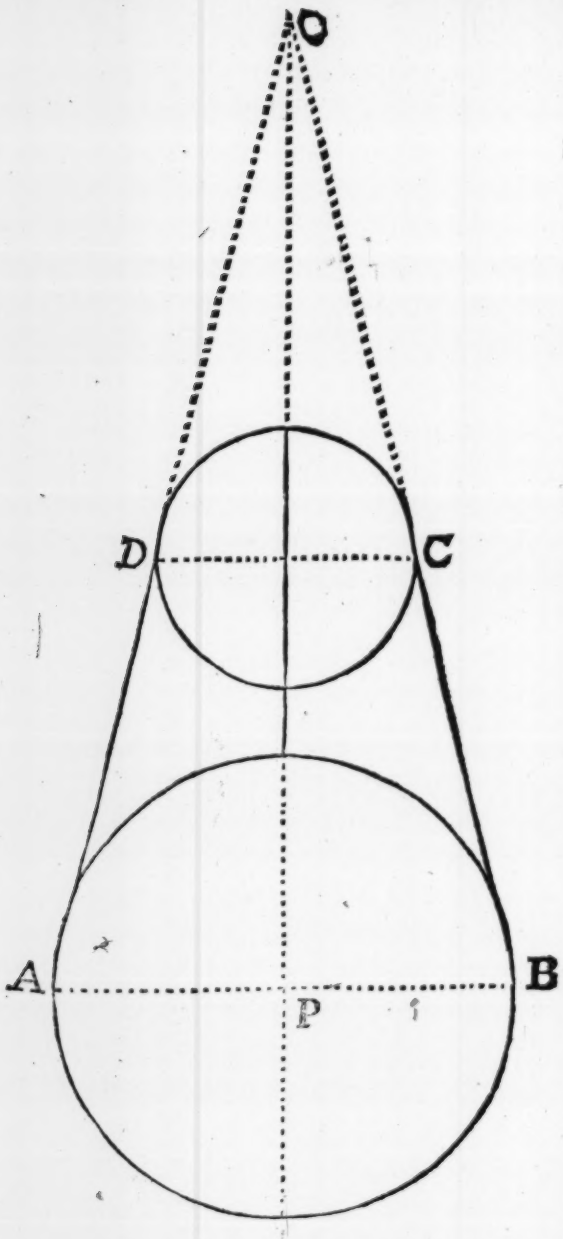
```
        76
        76
      ----
       456
      532
      ----
      5776
        51
      ----
      5776
     28880
     -----
      ...
359) 294576 (820 Beer gallons.
      737
      ----
       196
      ----

        294576
        .002785
      -------
       1472880
      2356608
     2062032
     589152
     ---------
Wine gallons  820|394160
     ---------
```

294)



Page 92. Problem 22.

B
E
C



(AOB) is a whole Cone and belongs to Problem 4.
(ABCD) is the Fruſtum of a Cone, and belongs to Prob. 13.
(O) is the Vertex, (OP) is the Axe or Altitude. (AB) Diam.

```
        ....
294) 294576 (1001 Wine gallons.
      00576
      -----
        282
      -----

        294576
          .0034
        -------
        1178304
        883728
        -------
Wine gallon. 1001|5584
```

Problem 4.

To find the Content of a Cone.

Square the Diameter and Multiply the Product by the Height. Then

$$\text{Divide by} \left\{ \begin{matrix} 1077 \\ 882 \end{matrix} \right\} \text{ for } \left\{ \begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix} \right\} \text{gallons.}$$

O R,

$$\text{Multiply by} \left\{ \begin{matrix} .000928 \\ .001133 \end{matrix} \right\} \text{ for } \left\{ \begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix} \right\} \text{gallons.}$$

Exam-

Example.

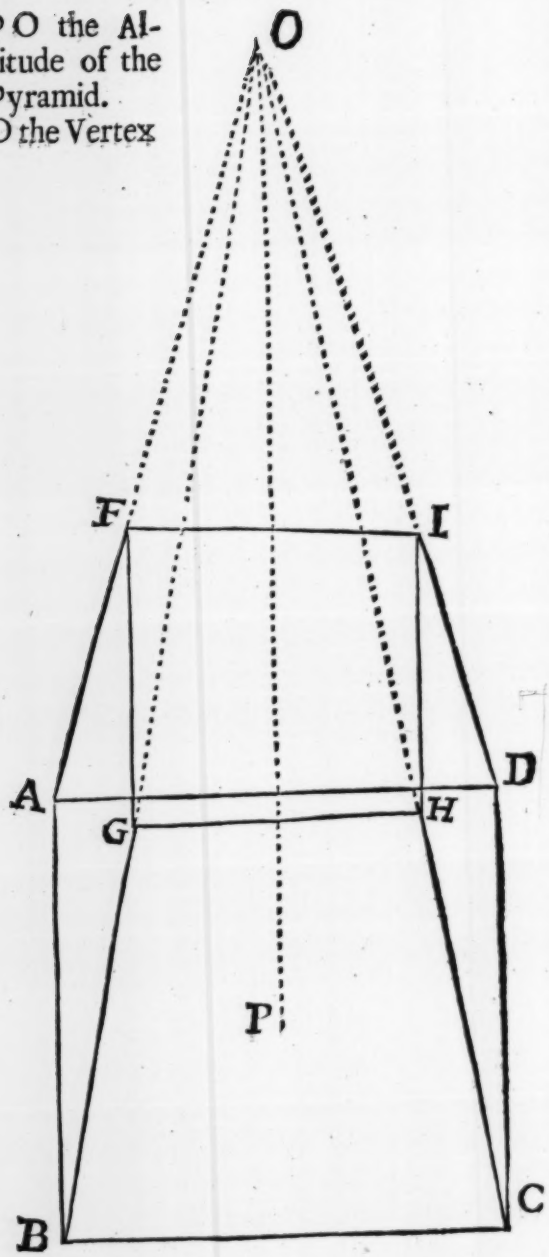
A Cone whose Diameter is 84 inches, and Height 111 inches, I would know the Content in Beer and Wine gallons?

```
                84
                84
              ----
               336
              672
            ------
             7056
              111
            ------
             7056
            7056
           7056
          -------
                ...
1077) 783216 (727 Beer gallons.
        2931
         7776
        -----
          237
        -----

          783216
          .000928
        -------
         6265728
        1566432
       7048944
      ---------
Beer gallons  726|824448
      ---------
```

882)

E
G
C
A

PO the Altitude of the Pyramid.
O the Vertex



ABCDO is a whole ſquare Pyramid and belongs to Prob. 5.
ABCDIHGF is the Fruſtum of a Pyramid and belongs to Problem 11.

882) 783216 (888 Wine gallons.
7761
7056

0

783216
.001133

2349648
2349648
783216
783216

Wine gallons. 887|383728

Problem 5.

To find the Content of a Square Pyramid.

Square the side, and Multiply the Product by the Height. Then,

Divide by $\left\{\begin{matrix}8,46\\693\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

O R,

Multiply by $\left\{\begin{matrix}.001182\\.001443\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

Example.

A Square Pyramid, the Side is 86 inches, and Height 142 inches, I would know the Content in Beer and Wine gallons?

```
          86
          86
        ----
         516
        688
       -----
        7396
         142
      -------
       14792
      29584
      7396
     -------
        ....
846) 1050232 (1241 Beer gallons.
      2042
       3503
        1192
      -------
         346
      -------

          1050232
           .001182
        ---------
          2100464
         8401856
        1050232
       1050232
      ---------
Beer gallons 1241|374224
```

693)

```
          ....
693 (1050232 (1515 Wine gallons.
      3572
       1073
        3802
      ------
         337
      ------

       1050232
       ·001443
      ---------
        3150696
       4200928
      4200928
     1050232
     ----------
Wine gallons.1515|484776
     ----------
```

Problem 6.

To find the Content of a Parabolick Pyramidoid.

Multiply the side of the Square at bottom by it self, Multiply that Product by the Height. Then,

Divide by $\left\{\begin{matrix}564\\462\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

O R,

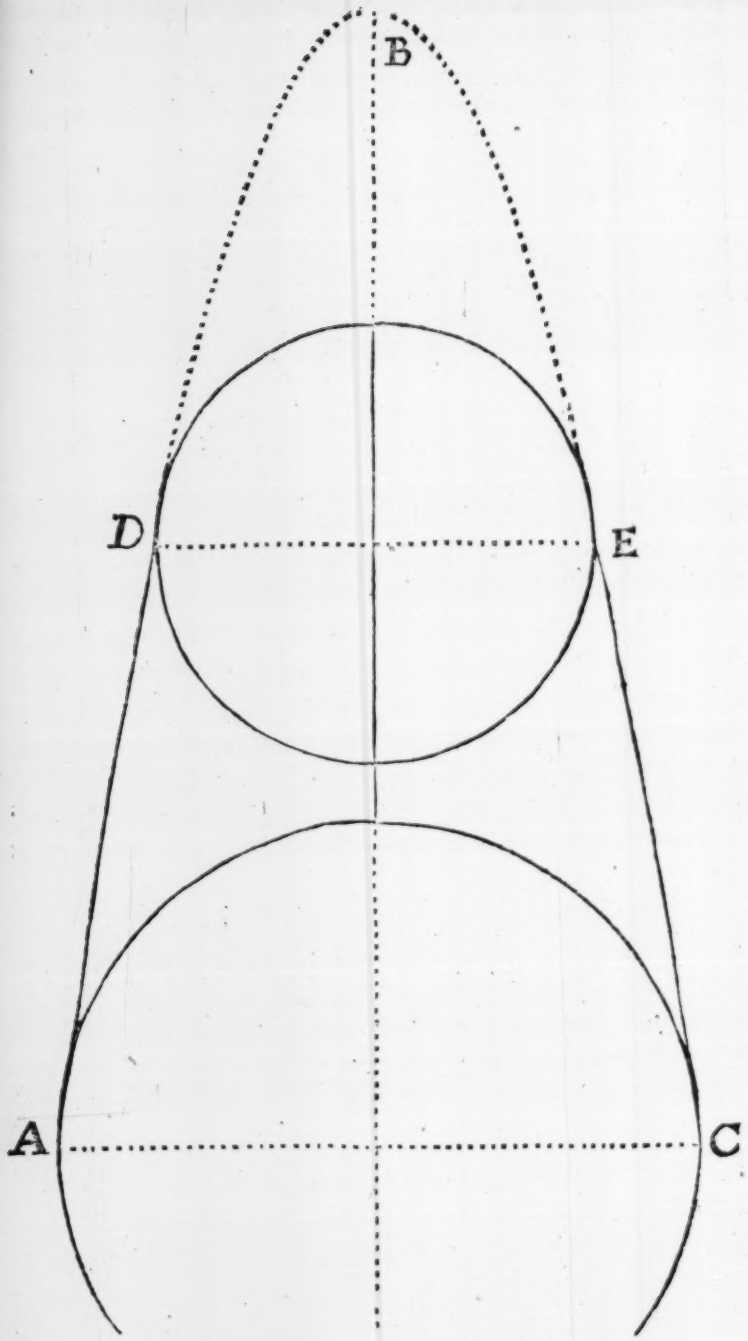
Multiply by $\left\{\begin{matrix}.001773\\.002164\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

Example.

A Parabolick Pyramidoid ſide of the Square at bottom is 78 inches, height is 66 inches, I would know the Solid Content in Beer and Wine gallons.

```
        78
        78
      ----
       624
      546
      ----
      6084
        66
      -----
     36504
    36504
    -------
      . . .
564) 401544 (711 Beer gallons.
       674
       1104
      -----
        540
      -----

          401544
          .001773
        -------
          1204632
         2810808
        2810808
        401544
        ---------
Beer gallons. 711|937512
        ---------
```

462)



(ABC) is a Parabolick Conoid and belongs to Problem 7.
(ACED) is the Lower Fruſtum of a Parabolick Conoid and belongs to Problem 14.

462) 401544 (869 Wine gallons.
3194
4224
66

401544
·002164
1606176
2409264
401544
803088
Wine gallons. 868|941216

Problem 7.

To find the Content of a Parabolick Conoid.

Square the Diameter, multiply the Product by the Height. Then,

Divide by {718 / 588} for {Beer / Wine} gallons.

O R,

Multiply by {.0013925 / .0017} for {Beer / Wine} gallons.

Exam-

Example.

A Parabolick Conoid, Diameter is 67 inches, and Height 95 inches, I would know the Content in Beer and Wine gallons?

67
67

469
402

4489
95

22445
40401

...
718) 426455 (593 Beer gallons.
6745
2835

681

426455
.001392

852910
3838095
1279365
426455

Beer gallons. 593|625360
---

588)

588) 426455 (725 Wine gallons.
1485
3095
155

426455
.0017
2985185
426455
Wine gallons. 724|9735

Problem 8.

To find the Content of an Hyperbolick Conoid.

Square the Diameter, multiply the Product by the Height. Then,

Divide by {862 / 706} for {Beer / Wine} gallons.

O R,

Multiply by {.0011601 / .0014164} for {Beer / Wine} gallons.

Exam-

Example.

An Hyperbolick Conoid Diameter is 81 inches, Height is 76 inches, I would know the Content in Beer and Wine gallons?

```
          81
          81
        ----
          81
         648
        ----
        6561
          76
        ----
       39366
      45927
      ------
        ...
862) 498636 (578 Beer gallons
      6763
       7296
      ------
        400
      ------

       498636
      .001160
      -------
     29918160
     498636
    498636
    -------
Beer gallons. 578|417760
```

706)

706) 498636 (706 Wine gallons.
04436
200.

498636
.001416
2991816
498636
1994544
498636
Wine gallons 706|068576

Problem 9.

To find the Content of a Globe.

Cube the Globes Diameter (or Multiply the Diameter of the Globe by it self, and the Product again Multiply by the Globes Diameter) Then,

Divide by {538 / 441} for {Beer / Wine} Gallons.

O R,

Multiply by {.001859 / .002267} for {Beer / Wine} Gallons.

Example.

inch.

A Globe whoſe Diameter is 61.7. I would know the Content in Beer and Wine gallons?

61.7
61.7

4319
617
3702

3806.89
61.7

2664823
380689
2284134

538) 234885|113 (436 Beer gallons.
1968
3545
317

234885
·001859

2113965
1174425
1879080
234885

Beer gallons 436|651215

441)

441) 234885 (532 Wine gallons.
1438
1155
273

234885
·002267

1644195
1409310
469770
469770

Wine gallons 532|484295

Problem 10.

To find the Content of a whole Spheroid.

Multiply the Square of the Conjugate (or ſhorteſt Diameter by the Tranſverſe (or longeſt Diameter.) Then,

Divide by {538 / 441} for {Beer / Wine} gallons.

O R,

Multiply by {·001859 / ·002267} for {Beer / Wine} gallons.

Example.

inch.

A Spheroids Conjugate Diameter is 41.3, Tranſverſe Diameter 71.9. I would know the Content in Beer and Wine gallons.

41.3
41.3

1239
413
1652

1705.69
71.9

1535121
170569
1193983

. . .

538) 122639|111 (227 Beer gallons.
1503
4279

513

122639
.001859

1103751
613195
981112
122639

Beer gallons 227|985901

441)

441) 122639 (278 Wine gallons.
3443
3569
41

122639
.002267
858473
735834
245278
245278
Wine gallons 278|022613

Problem 11.

To find the Content of the Fruſtum of a Square Pyramid cut Parallel to the Baſe.

To the Treble Product of the Sides, add the Square of their Difference, Multiply the ſum by the Depth. Then,

Divide by $\begin{Bmatrix}846\\693\end{Bmatrix}$ for $\begin{Bmatrix}\text{Beer}\\\text{Wine}\end{Bmatrix}$ gallons.

O R,

Multiply by $\begin{Bmatrix}.001182\\.001443\end{Bmatrix}$ for $\begin{Bmatrix}\text{Beer}\\\text{Wine}\end{Bmatrix}$ gallons.

Exam-

Example.

The Fruſtum of a Square Pyramid; the greateſt Side 61.2 *Inch.*, the leaſt Side 51.6 *Inch.*, the Depth 48.7 *Inch.*. I would know the Content in Beer and Wine Gallons?

```
   61.2                                  9.6
   51.6                                  9.6
  ------                                ----
   3672                                  576
   612                                  864
  3060                                 ----
  -------                               92.16
  3157.92                              ----
        3
  -------
  9473.76
    92.16
  -------
  9565.92        846) 465860 (550 Beer gallons.
     48.7                4286
  -------               ----
  6696144                560
 7652736                ----
3826368
-------
465860.304
-------
```

```
     465860
     .001182
     -------
     931720
    3726880
    465860
   465860
   ---------
Beer gallons. 550|646520
```

693)

693) 465860 (672 Wine gallons.
5006
1550
164

465860
.001443
1397580
1863440
1863440
465860
Wine gall. 672|235980

Problem 12.

To find the Content of the Fruſtum of a Parabolick Pyramidoid, cut Parallel to the Baſe.

To the Square of the greateſt Side add the Square of the leaſt Side, Multiply the ſum by the Depth. Then,

Divide by $\left\{\begin{matrix}564\\462\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

O R,

Multiply by $\left\{\begin{matrix}.001773\\.002164\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

Exam-

Example.

The Fruſtum of a Parabolick Pyramidoid; the greateſt Side is 61.2, The leaſt Side 51.6, Depth 48.6, I would know the Content in Beer and Wine gallons?

61.2	51.6
61.2	51.6
1224	3096
612	516
3672	2580
3745.44	2662.56
2662.56	
6408.00	...
48.6	564)311428(552 Beer gall.
38448	2942
51264	1228
25632	100
311428.8	

311428
.001773

934284
2179996
2179996
311428

Beer gallons 552|161844

462)

462) 311428 (674 Wine gallons.
3422
1888
040

311428
.002164
1245712
1868568
311428
622856
Wine gallons 673.930192

Problem 13.

To find the Content of the Fruſtum of a Cone.

To the Treple Product of the Diameters, add the Square of their Difference, multiply the ſum by the Depth. Then,

Divide by {1077 / 882} for {Beer / Wine} gallons.

O R,

Multiply by {.000928 / .001133} for {Beer / Wine} gallons.

Example.

A Fruſtum of a Cone; the greateſt Diameter is 79.3, the leaſt Diameter is 68.5, Depth 49.7, I would know the Content in Beer and Wine gallons?

```
   79.3                          79.3
   68.5                          68.5
  ------                        ------
   3965                          108
  6344                           108
 4758                           ------
 ---------                        864
 543205                          1080
      3                         ------
 ---------                      116.64
 16296.15                       ------
   116.64
 ---------                   ...      (gall.
 16412.79          1077 (815715 (757 Beer
     49.7                  6181
 ---------                  7965
 11488953                  ------
 14771511                    426
 6565116                   ------
 ---------
 815715.663
 ---------

                 815715
                 .000928
                ---------
                 6525720
                1631430
               7341435
               ---------
Beer gallons   756|983520.
```

882)

882) 815715 (924 Wine gallons.
2191
4275
747

815715
·001133
2447145
2447145
815715
815715
Wine gallons. 924|205095

Problem 14.

To find the Content of the Frustum of a Parabolick Conoid, cut Parallel to the Base.

Multiply the Sum of the Squares of Top and Bottom Diameters by the Depth. Then,

Divide by $\left\{\begin{matrix}718\\588\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

O R,

Multiply by $\left\{\begin{matrix}.0013925\\.0017\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

 Exam-

Example.

A Fruſtum of a Parabolick Conoid; the greateſt Diameter is 79.3 *Inch.*, the leaſt Diameter 68.5 *Inch.*, Depth 49.7 *Inch.*, I would know the Content in Beer and Wine gallons?

79.3	68.5
79.3	68.5
2379	3425
7137	5480
5551	4110
6288.49	4692.25
4692.25	
10980.74	
49.7	
7686518	
9882666	
4392296	
545742.778	

718) 545742 (760 Beer gall.
4314
062

545742	
.001392	
10914.84	
4911678	
1637226	
545742	
Beer gallons. 759167286 4	

88)

588) 546239 (928 Wine gallons.
1703
5279
575

546239
·0017
3823673
546239
Wine gallons. 928|6063

Problem 15.

To find the Content of the Fruſtum of a Globe.

To the Treple Square of Fruſtums Diameter add 4 times the Square of its Height, this multiply by the Height. Then,

Divide by {2154 / 1764} for {Beer / Wine} gallons.

O R,

Multiply by {·000464 / ·000566} for {Beer / Wine} gallons.

Exam-

Example.

Inch. *Inch.*

A Fruſtum of a Globe Diameter is 71.5, the Height 31.2, I would know the Content in Beer gallons?

71.5
71.5

3575
715
5005

5112.25
3

15336.75
3893.76

19230.51
31.2

3846102
1923051
5769153

599991.912

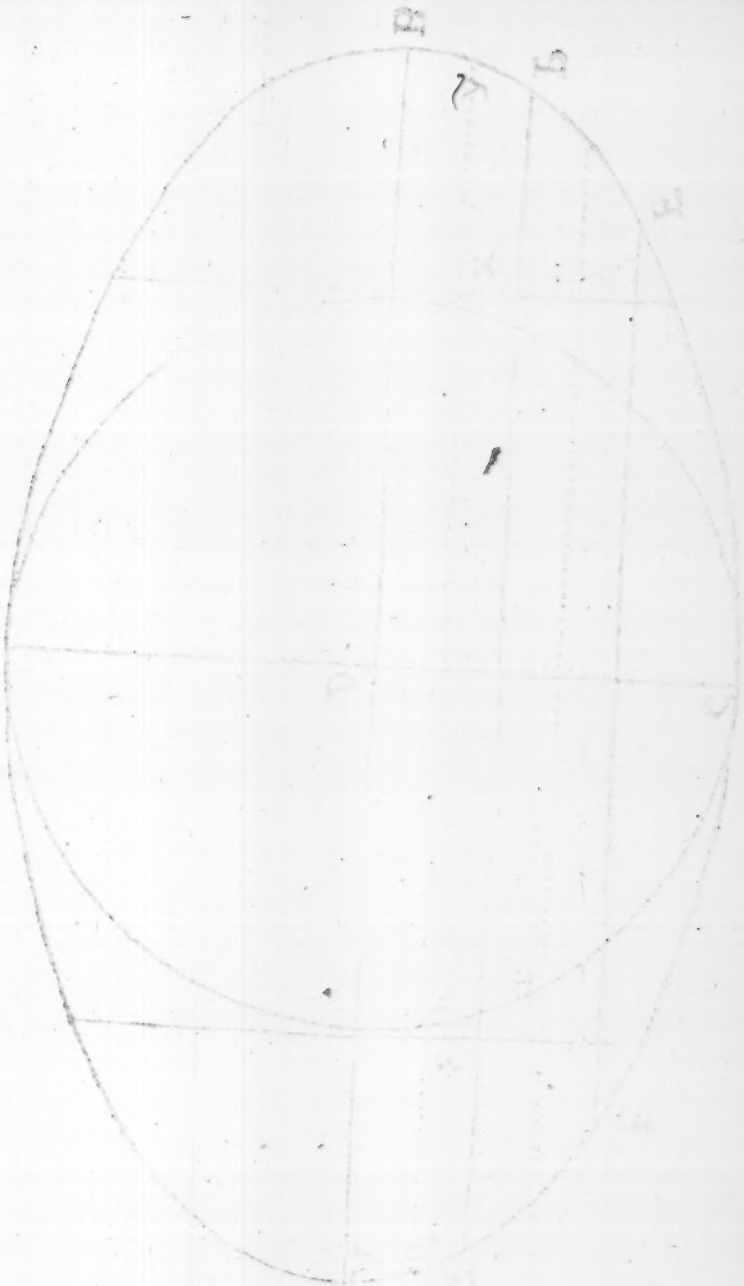
31 2
31.2

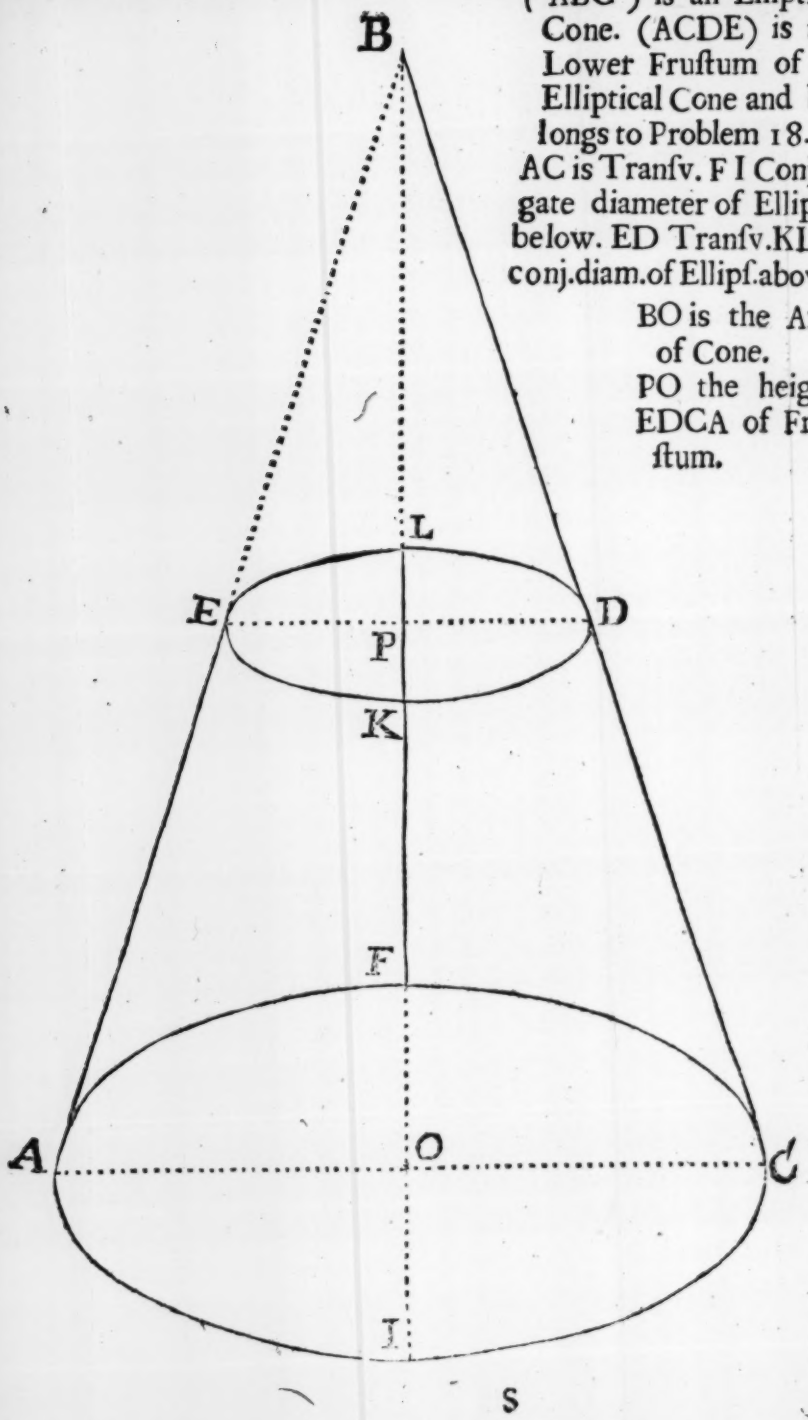
624
312
936

973.44
4

3893.76

2154)





(ABC) is an Elliptical Cone. (ACDE) is the Lower Fruſtum of an Elliptical Cone and belongs to Problem 18.

AC is Tranſv. F I Conjugate diameter of Ellipſis below. ED Tranſv. KL is conj. diam. of Ellipſ. above.

BO is the Axe of Cone.

PO the height EDCA of Fruſtum.

```
          ...
2154) 599991 (278 Beer gallons.
      16919
       18411
      ------
        1179
      ------

        599991
       .000464
      --------
       2399964
      3599946
     2399964
     ---------
Beer gallons. 278|395824
```

Problem 18.

To find the Content of the Frustum of an upright Elliptick Cone cut Parallel to the Base.

Multiply the Rectangle of the Top Diameters by the Rectangle of the Bottom Diameters, and Extract the Square Root which add to the sum of the said Rectangles, multiply the last by the Depth. Then,

$$\text{Divide by} \left\{ \begin{matrix} 1077 \\ 882 \end{matrix} \right\} \text{ for } \left\{ \begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix} \right\} \text{gallons.}$$

O R,

$$\text{Multiply by} \left\{ \begin{matrix} .000928 \\ .001133 \end{matrix} \right\} \text{ for } \left\{ \begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix} \right\} \text{gallons.}$$

Exam-

Example.

inch.

The Fruſtum of an Elliptick Cone { Greateſt diam. at Top—75 / Leaſt diameter at Top—50 / Greateſt diam. at Bott.—87 / Leaſt diameter at Bott.—58 / Depth——47 } I would know the Content in Beer and Wine gallons.

87
58

696
435

5046
3750

25230
35322
15138

18922500

75
50

3750

24300

24300
18922500 (4350
48368 5046
8 3750
13146
47
92022
52584
1077) 617862 (573 Beer gallons.
7936
3972
741
617862
.000928
4942896
1235724
5560758
Beer gallons. 573|375936

Problem 17.

To find the Content of a Cask taken for the middle Fruſtum of a Spheroid.

To twice the Square of the Bung add once the Square of the Head, multiply the Sum by the length. Then

Divide by {1077 / 882} for {Beer / Wine} gallons.

O R,

Multiply by {.000928 / .001133} for {Beer / Wine} gallons.

H

Exam-

Example.

A Cask { Bung ——— 31.7 / Heads ——— 24.3 / Length —— 49.3 } I would know the Content in Beer and Wine gallons?

31.7	24.3
31.7	24.3
2219	729
317	972
951	486
1004.89	590.49
1004.89	
590.49	
2600.27	
49.3	
780081	
2340243	
1040108	
128193.311	

1077) 128193 (119 Beer gallons
2049
9723
30

128193
.000928

1025544
256386
1153737

Beer gallons. 118963104

882)

882) 128193 (145 Wine gallons.
3999
4713
303

128193
.001133
384579
384579
128193
128193
Wine gall. 145.1242669

Problem 18.

To find the Content of a Cask taken for the middle Fruſtum of a Parabolick Spindle.

To 8 times the Square of the Bung add 7 times the Square of the Head, multiply the ſum by the Length. Then,

Divide by $\left\{\begin{matrix}5387\\4412\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

O R,

Multiply by $\left\{\begin{matrix}.0001857\\.0002267\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

Example.

A Cask { Bung —— 31.7 / Heads —— 24.3 / Length —— 49.3 } I would know the Content in Beer and Wine gallons?

31.7
31.7
2219
317
951
1004.89
8
8039.12
4133.43
12172.55
49.3
3651765
10955295
4869020
600106.715

24.3
24.3
729
972
486
590.49
7
4133.43

5387)600106(111 Beer gall.
6140
7536
2149

600106
.0001857
4200742
3000530
4800848
600106
Beer gallons 111143968 42

4412)

```
          . . .
4412) 600106 (136 Wine gallons.
      15890
       26546
      ------
         074
      ------

              600106
             .0002267
             --------
              4200742
             3600636
            1200212
           1200212
           ---------
Wine gallons  136|0440302
```

This is Doctor Newton's *Theorem for a Parabolick spindle in his* Cosmography.

A Theorem betwixt the Middle Frustum of a Parabolick Spindle, and the Middle Frustum of two equal Parabolick Conoids.

Problem 19.

To 3 times the Square of the Bung add 2 times the Square of Head, Multiply the Sum by the Length. Then,

$$\text{Divide by} \left\{\begin{matrix} 1796 \\ 1471 \end{matrix}\right\} \text{ for } \left\{\begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix}\right\} \text{Gallons.}$$

O R,

$$\text{Multiply by} \left\{\begin{matrix} .000557 \\ .00068 \end{matrix}\right\} \text{ for } \left\{\begin{matrix} \text{Beer} \\ \text{Wine} \end{matrix}\right\} \text{Gallons.}$$

Exam-

Example.

A Cask { Bung —— 31.7 / Heads —— 24.3 / Length —— 49.3 } I would know the Content in Beer and Wine gallons?

31.7
31.7

2219
317
951

1004.89
3

3014.67
1180.98

4195.65
49.3

1258695
3776085
1678260

206845.545

24.3
24.3

729
972
486

590.49
2

1180.98

... (gall.
1796) 206845 (115 Beer
2724
9285

305

206845
.000557

1447915
1034225
1034225

Beer gallons 115121266$\frac{5}{1471}$

1471) 206845 (140 Wine gallons.
5974

0905

206845
· 00068

1654760
1241070

Wine gallons. 140165460

To find the Quantity of Liquor remaining in a Spheroidal Cask when it ſtands upon the Head, viz. When the Axe is Perpendicular to the Horizon.

Problem 20.

From thrice the Square of the Semi-length, ſubtract the Square of the diſtance of Liquors ſurface from Bung, multiply the remainder by the ſquare of the Bung; which add to the Product of the ſquares of the Head and diſtance of Liquors ſurface, this ſum multiply by the ſaid diſtance, and Divide by the ſquare of the Semi-length. Then

Divide by { 1077 / 832 } for { Beer / Wine } gall. above or under half the content of the Veſſel.

O R,

Multiply by { 000928 / .001133 } for { Beer / Wine } gallons.

Exam-

Example.

Bung —— 29
Heads —— 23
Length- — —42
Wet inches–28

} Measured as a Spheroid contains 86 gall. 2.

The Operation.

From 28 Wet inches.
Take 21 the Semi-length.

Rests 7
7

} distance of Liquors surface from Bung.

49

21 Semi-length.
21
21
42
441
3
1323
49
1274
841
1274
5096
10192
1071434
25921
1097355
7
7681485

29
29
261
58
841
23
23
69
46
529
49
4761
2116
25921

441)

```
          1077)
          .....      ....
441) 7681485 (1741800 (16|17 Liquor above half.
     3271       6648     43.1
      1844       1860    ------
       808       7830    59.27 Remaining Liquor.
      3675      ------   ------
     ------       291
       147      ------
     ------
```

To find the Quantity of Liquor remaining or drawn forth in any Spheroidal Cask, the Vessel standing upon the Head, the Axe *Perpendicular to the Horizon, by Tables of Frustums of a Spheroid.*

IN the Table of Bung and Head Diameters in Proportion under (HD.), look the Head Diameter, then right against it in the Columns (1) (2) (3) or (4) find the Bung Diameter, or the nearest noting the Number at Top: Then, by the Rule of Three, as the length of the Vessel is to 100: so is the Wet or Dry inches to a Number, which look'd in Tables of a Spheroid standing under Axe, and right against it in the same Column of (1) (2) (3) or (4) where before you found the Bung answers a Number, by which if you multiply the whole Content you have the Liquor remaining or drawn forth.

A Cask standing on a Head, the Bung 28 inches, the Heads 24, the Length 38. contains 75 gall. If 26 inches be wet, I would know the Liquor remaining ?

Example.

Finding the Head Diameter under (HD.) in the Table of Bung and Head Diameters in Proportion, right againſt it the neareſt to the Bung I find under (2) which reſerve,

Then, As 38, to 100: So 26 inches VVet.

26

38) 2600 (68 this I look in the Table
320 under Axe, and right
16 againſt in the Column
under (2)

I find .695
75

3475
4865

52|125

There remains 52.125 gallons in the Veſſel.

As 38, to 100: ſo is 12 inches Dry.

12

38) 1200 (31 which look in the Table under
60 Axe, and right againſt it in
22 the Column under (2) you
find .295, which multiply by
the whole Content 75 gallons
gives 22.125 drawn forth.

To

To find the Liquor remaining or drawn forth, the Spheroidal Cask Lying, viz. *Its Axe Parallel to the Horizon, by Tables of Spheroid Lying.*

IN the Table of Bung and Head Diameters in Proportion, find the Head Diameter under (HD.) and right againſt find the neareſt to the Bung in the Columns of (1) (2) (3) or (4) which reſerve.

Then ſay, As the Bung Diameter to 100: ſo is the Wet or Dry inches to a Number, which find in the Table of Spheroid Lying under (VS), obſerve the Number right againſt in the ſame reſerved Column, which multiply by the whole Content and you have the Liquor remaining or drawn forth.

Bung 29.3 Heads 23.2 contains 107 gallons, if 19 be Wet, I would know the Wet and Dry gallons?

In Table of Bung and Head Diameters in Proportion, I find the Head and the neareſt to the Bung in the 4 Column.

Then As the Bung 29.3 to 100: ſo is 19 inches wet to 64, which found under (VS) in the Table of Spheroid lying, right againſt in the (4) Column you have .689 which multiplyed by the whole Content 107 gallons gives 731723 the gallons wet.

Again, As 29.3 to 100: ſo 10.3 the Dry inches to 35, which found under (VS) directly againſt in (4) Column anſwers .298, which multiplied by 107 gives the dry gallons 31.886.

A

TABLE

Of Bung and Head Diameters in Proportion.

H.D.	1	2	3	4
10.0	11.00	11.60	12.20	12.80
.2	11.22	11.83	12.44	13.06
.4	11.44	12.06	12.69	13.31
.6	11.66	12.30	12.93	13.57
.8	11.88	12.53	13.18	13.82
11.0	12.10	12.76	13.42	14.08
.2	12.32	12.99	13.60	14.34
.4	12 54	13.22	13.91	14.59
.6	12.76	13.46	14.15	14.85
.8	12.98	13.69	14.40	15.10
12.0	13 20	13.92	14.64	15.36
.2	13.42	14.15	14.88	15.62
.4	13.64	14.38	15.13	15.87
.6	13.86	14.62	15.37	16.13
.8	14.08	14.85	15.62	16.38
13.0	14.30	15.08	15.86	16.64
.2	14.52	15.31	16.10	16.90
.4	14.74	15.54	16.35	17.15
.6	14.96	15.78	16.59	17.41
.8	15.18	16.01	16.84	17.66
14.0	15.40	16.24	17.08	17.92
.2	15.62	16.47	17.32	18.18
.4	15.84	16.70	17.57	18.43
.6	16.06	16.94	17.81	18.69
.8	16.28	17.17	18.06	18.94
15.0	16.50	17.40	18.30	19.20
.2	16.72	17.63	18.54	19.46
.4	16.94	17.86	18.79	19.71
.6	17.16	18.10	19.03	19.97
.8	17.38	18.33	19.28	20.22

H D.	1	2	3	4
16.0	17.60	18.56	19.52	20.48
.2	17.82	18.79	19.76	20.74
.4	18.04	19.02	20.01	20.99
.6	18.26	19.26	20.25	21.25
.8	18.48	19.49	20.50	21.50
17.0	18.70	19.72	20.74	21.76
.2	18.92	19.95	20.98	22.02
.4	19.14	20.18	21.23	22.27
.6	19.36	20.42	21.47	22.53
.8	19.58	20.65	21.72	22.78
18.0	19.80	20.88	21.96	23.04
.2	20.02	21.11	22.20	23.30
.4	20.24	21.34	22.45	23.55
.6	20.46	21.58	22.69	23.81
.8	20.68	21.81	22.94	24.06
19.0	20.90	22.04	23.18	24.32
.2	21.12	22.27	23.42	24.58
.4	21.34	22.50	23.67	24.83
.6	21.56	22.74	23.91	25.09
.8	21.78	22.97	24.16	25.34
20.0	22.00	23.20	24 40	25.60
.2	22.22	23.43	24.64	25 86
.4	22.44	23.66	24.89	26.11
.6	22.66	23.90	25 13	26.37
.8	22 88	24.13	25.38	26.62
21.0	23.10	24.36	25.62	26.88
.2	23 32	24.59	25.86	27.14
.4	23.54	24.82	26.11	27.39
.6	23.76	25.06	26.35	27.65
.8	23.98	25.29	26.60	27.00

Bung and Head Diameters in Proportion.

H.D.	1	2	3	4
22.0	24.20	25.52	26.84	28.16
.2	24.42	25.75	27.08	28.42
.4	24.64	25.98	27.33	28.67
.6	24.86	26.22	27.57	28.93
.8	25.08	26.45	27.82	29.18
23.0	25.30	26.68	28.06	29.44
.2	25.52	26.91	28.30	29.70
.4	25.74	27.14	28.55	29.95
.6	25.96	27.38	28.79	30.21
.8	26.18	27.61	29.04	30.46
24.0	26.40	27.84	29.28	30.72
.2	26.62	28.07	29.52	30.98
.4	26.84	28.30	29.77	31.23
.6	27.06	28.54	30.01	31.49
.8	27.28	28.77	30.26	31.74
25.0	27.50	29.00	30.50	32.00
.2	27.72	29.23	30.74	32.26
.4	27.94	29.46	30.99	32.51
.6	28.16	29.70	31.23	32.77
.8	28.38	29.93	31.48	33.02
26.0	28.60	30.16	31.72	33.28
.2	28.82	30.39	31.96	33.54
.4	29.04	30.62	32.20	33.79
.6	29.26	30.86	32.45	34.05
.8	29.48	31.09	32.70	34.30
27.0	29.70	31.32	32.94	34.56
.2	29.92	31.55	33.18	34.82
.4	30.14	31.78	33.43	35.07
.6	30.36	32.02	33.67	35.33
.8	30.58	32.25	33.92	35.58
28.0	30.80	32.48	34.16	35.84
.2	31.02	32.71	34.40	36.10
.4	31.24	32.94	34.65	36.35
.6	31.46	33.18	34.89	36.61
.8	31.68	33.41	35.14	36.86

H.D.	1	2	3	4
29.0	31.90	33.64	35.38	37.12
.2	32.12	33.87	35.62	37.38
.4	32.34	34.10	35.87	37.63
.6	32.56	34.34	36.11	37.89
.8	32.78	34.57	36.36	38.14
30.0	33.00	34.80	36.60	38.40
.2	33.22	35.03	36.84	38.66
.4	33.44	35.26	37.09	38.91
.6	33.66	35.50	37.33	39.17
.8	33.88	35.73	37.58	39.42
31.0	34.10	35.96	37.82	39.68
.2	34.32	36.19	38.06	39.94
.4	34.54	36.42	38.31	40.19
.6	34.76	36.66	38.55	40.45
.8	34.98	36.89	38.80	40.70
32.0	35.20	37.12	39.04	40.96
.2	35.42	37.35	39.28	41.22
.4	35.64	37.58	39.53	41.47
.6	35.86	37.82	39.77	41.73
.8	36.08	38.05	40.02	41.98
33.0	36.30	38.28	40.26	42.24
.2	36.52	38.51	40.50	42.50
.4	36.74	38.74	40.75	42.75
.6	36.96	38.98	40.99	43.01
.8	37.18	39.21	41.24	43.26
34.0	37.40	39.44	41.48	43.52
.2	37.62	39.67	41.72	43.78
.4	37.84	39.90	41.97	44.03
.6	38.06	40.14	42.21	44.29
.8	38.28	40.37	42.46	44.54
35.0	38.50	40.60	42.70	44.80
.2	38.72	40.83	42.94	45.05
.4	38.94	41.06	43.19	45.31
.6	39.16	41.30	43.43	45.57
.8	39.38	41.53	43.68	45.82

A TABLE FOR

CASKS Standing: Or, a Table for the Middle Fruſtum of a SPHEROID, having its AXE Perpendicular to the Horizon; partly Full, and partly Empty.

Axe.	1	2	3	4
.01	.009	.008	.008	.007
.02	.018	.017	.015	.014
.03	.027	.025	.023	.021
.04	.036	.033	.031	.029
.05	.045	.042	.039	.036
.06	.054	.051	.047	.044
.07	.063	.060	.056	.052
.08	.072	.068	.064	.060
.09	.082	.077	.073	.069
.10	.091	.087	.082	.077
.11	.101	.096	.091	.086
.12	.110	.105	.100	.095
.13	.120	.114	.109	.104
.14	.129	.124	.118	.113
.15	.139	.133	.127	.122
.16	.149	.143	.137	.131
.17	.159	.153	.147	.141
.18	.168	.162	.156	.150
.19	.178	.172	.166	.160
.20	.188	.182	.176	.170

Axe.	1	2	3	4
.21	.198	.192	.186	.180
.22	.208	.202	.196	.190
.23	.218	.212	.206	.200
.24	.228	.222	.216	.210
.25	.239	.233	.226	.220
.26	.249	.243	.237	.231
.27	.259	.253	.247	.241
.28	.269	.263	.257	.251
.29	.279	.274	.268	.262
.30	.290	.284	.278	.273
.31	.300	.295	.289	.284
.32	.310	.305	.300	.285
.33	.321	.316	.311	.306
.34	.331	.327	.322	.317
.35	.342	.337	.333	.328
.36	.352	.348	.344	.340
.37	.363	.359	.355	.351
.38	.373	.369	.365	.362
.39	.383	.380	.376	.373
.40	.394	.391	.388	.385

A Table for Casks Standing:

Axe.	1	2	3	4
.41	.405	.402	.399	.396
.42	.415	.413	.410	.407
.43	.426	.424	.421	.419
.44	.436	.434	.432	.430
.45	.447	.445	.444	.442
.46	.458	.456	.455	.453
.47	.468	.467	.466	.465
.48	.479	.478	.477	.477
.49	.489	.489	.489	.488
.50	.500	.500	.500	.500
.51	.511	.511	.511	.512
.52	.521	.522	.523	.523
.53	.532	.533	.534	.535
.54	.542	.544	.545	.547
.55	.553	.555	.556	.558
.56	.564	.566	.568	.570
.57	.574	.576	.579	.581
.58	.585	.587	.590	.593
.59	.595	.598	.601	.604
.60	.606	.609	.612	.615
.61	.617	.620	.624	.627
.62	.627	.631	.635	.638
.63	637	.641	.645	.649
.64	.648	652	.656	.660
.65	.658	.663	.667	.672
.66	.669	.673	.678	.683
.67	.679	.684	.689	.694
.68	.690	.605	.700	.705
.69	.700	.705	.711	.716
.70	.710	.716	.722	.727

Axe.	1	2	3	4
.71	.721	.726	.732	.738
.72	.731	.737	.743	.749
.73	.741	.747	.753	.759
.74	.751	.757	.763	.769
.75	.761	.767	.774	.780
.76	.772	.778	.784	.790
.77	.782	.788	.794	.800
.78	.792	.798	.804	.810
.79	.802	.808	.814	.820
.80	.812	.818	.824	.830
.81	.822	.828	.834	.840
.82	.832	.838	.844	.850
.83	.841	.847	.853	.859
.84	.851	.857	.863	.869
.85	.861	.867	.873	.878
.86	.871	.876	.882	.887
.87	.880	.886	.891	.896
.88	.890	.895	.900	.905
.89	.899	.904	.909	.914
.90	.909	.913	.918	.923
.91	.918	.923	.927	.931
.92	.928	.932	.936	.940
.93	.937	.940	.944	.948
.94	.946	.949	.953	.956
.95	.955	.958	.961	.964
.96	.964	.967	.969	.971
.97	.973	.975	.977	.979
.98	.982	.983	.985	.986
.99	.991	.992	.992	.993

A

TABLE

FOR

Finding the Vacuity of Lying CASKS: Or, a Table for the Middle Fruſtum of a SPHEROID, having its *Axe* Parallel to the Horizon; and divided by places Parallel to the ſaid *Axe*; whoſe Solidity is (1).

V.S.	1	2	3	4
.01				
.02	.001			
.03	.003	.001		
.04	.007	.005	.002	.001
.05	.012	.008	.006	.003
.06	.017	.013	.010	.007
.07	.023	.019	.015	.012
.08	.029	.025	.021	.018
.09	.036	.032	.028	.024
.10	.043	.039	.034	.030
.11	.051	.046	.042	.038
.12	.059	.054	.050	.046
.13	.067	.062	.058	.054
.14	.076	.071	.066	.062
.15	.085	.080	.075	.071
.16	.094	.089	.084	.080
.17	.103	.098	.094	.090
.18	.113	.108	.104	.100
.19	.123	.118	.114	.110
.20	.133	.128	.124	.120

V.S.	1	2	3	4
.21	.144	.139	.135	.131
.22	.154	.150	.145	.141
.23	.165	.161	.156	.152
.24	.176	.172	.167	.164
.25	.187	.183	.179	.175
.26	.199	.194	.190	.186
.27	.212	.206	.202	.198
.28	.222	.218	.214	.210
.29	.233	.229	.226	.222
.30	245	241	.238	.234
.31	.257	.253	.250	.247
.32	.270	.266	.262	.260
.33	.282	.278	.275	.272
.34	.294	.290	.288	.285
.35	.307	.303	.301	.298
.36	.319	.316	.314	.311
.37	.332	.329	.326	.324
.38	.344	.342	.340	.337
.39	.357	.355	.353	.351
.40	.370	.368	.366	.364

A Ta-

A Table for Casks Lying :

V.S.	1	2	3	4
.41	.383	.381	.379	.377
.42	.396	.394	.392	.391
.43	.409	.407	.406	.404
.44	.422	.420	.419	.418
.45	.435	.433	.432	.432
.46	.448	.447	.446	.445
.47	.461	.460	.460	.459
.48	.474	.473	.473	.473
.49	.487	.487	.487	.486
.50	.500	.500	.500	.500
.51	.513	.513	.513	.514
.52	.526	.527	.527	.527
.53	.539	.540	.540	.541
.54	.555	.553	.554	.555
.55	.565	.567	.568	.568
.56	.578	.580	.581	.582
.57	.591	.593	.594	.596
.58	.604	.606	.608	.609
.59	.617	.619	.621	.623
.60	.630	.632	.634	.636
.61	.643	.645	.647	.649
.62	.656	.658	.660	.663
.63	.668	.671	.674	.676
.64	.681	684	.686	.689
.65	.693	.697	.699	.702
.66	.705	.710	.712	.715
.67	.718	.722	.725	.728
.68	.730	.734	.738	.740
.69	.743	.747	.750	.753
.70	.755	.759	.762	.768

V.S.	1	2	3	4
.71	.767	.771	.774	.778
.72	.778	.782	.786	.790
.73	.790	.794	.798	.802
.74	.801	.806	.810	.814
.75	.813	.817	.821	.825
.76	.824	.828	.833	.836
.77	.835	.839	.844	.848
.78	.846	.850	.855	.859
.79	.856	.861	.865	.869
.80	.867	.872	.876	.880
.81	.877	.882	.886	.890
.82	.887	.892	.896	.900
.83	.897	.902	.906	.910
.84	.906	.911	.915	.919
.85	.915	.920	.925	.929
.86	.924	.929	.934	.938
.87	.933	.938	.942	.946
.88	.941	.946	.950	.954
.89	.949	.954	.958	.962
.90	.957	.961	.966	.970
.91	.964	.968	.972	.976
.92	.971	.975	.979	.982
.93	.977	.981	.985	.988
.94	.983	.987	.990	.993
.95	.988	.992	.994	.997
.96	.993	.995	.998	.999
.97	.997	.999		
.98	.999			
.99				

To Calculate Diagonal Tables or Lines for Casks.

BY the Bung, Head, and Length; find the Content by the Bung, Head and Length, find the Diagonal by the following: To the ſquare of the ſum of the Diameters, add the ſquare of the Length, the ſquare Root of $\frac{1}{4}$ of the ſum will be the Diagonal. Then by the Rule of Three: As the Content of the Veſſel, to the Cube of its Diagonal; ſo is 1, 2, 3, 4. *&c.* To the Cubes of their Diagonals: whoſe Cubic-Roots will be the Diagonals for the Content given. Theſe Diagonals ſatisfactorily ſerve for Veſſels of the ſame Form but not otherwiſe.

Example.

A Barrel { Bung —— 23 / Heads —— 19.9 / Length —— 27 } Meaſured as the Middle Fruſtum of a Spheroid contains gall. 36 45 and the Diagonal will be, Inches 25.34, whoſe Cube will be, 16277 inches. If you deſire the Logarithm Tables, the Diagonals will be readily found: For if to the Logarithm

gall. gall. gall gall.

of 16277, you add the Logarithm of 1, 2, 3, 4. *&c.* and from every of the ſums you take the Logarithms of gall. 36.45 then the number anſwering to $\frac{1}{3}$ of each remainder will be the Diagonal ſought.

To

Inches.	Logarithms.
To 16277	4.21157
Add 1 gallon	0.00000
Sum	4.21157
Take 36.45 gall.	1.56170
Remain	2.64987
Diagonal inches 7.65 is $\frac{1}{3}$ Rem.	0.88329

inches.	Logarithms
To 16277	4.21157
Add 2 Gallons	0.30103
Sum	4.51260
Take 36.45 gallons	1.56170
Remain	2.95090
Diagonal inch. 9.63 is $\frac{1}{3}$ Remain	0.98363

Inches	Logarithms.
To 16277	4.21157
Add 3 Gallons	0.47712
	4.68869
gall.parts.	
Take 36.45	1.56170
Remain	3.12699
Diagonal inches 11.03 is $\frac{1}{3}$ Rem.	1.04233

Otherwiſe.

Inches.	Logarithms.
From 16277	4.21157
Take 36.45 gall.	1.56170
Remainder is	2.64987

The common Addend which added to the Logarithms of 1 gallon, 2 gallons, 3 gallons, *&c*; then $\frac{1}{3}$ of every of the ſumms will be the Logarithms of the Diagonals ſought?

	Logarith.
	2.64987
1 Gall.	0.00000
	2.64987
Diagonal inches 7.65 is $\frac{1}{3}$ Remain	0.88329

	Log.
	2.64987
	0.30103
	2.95090
Diagonal inches 9.63 is the $\frac{1}{3}$ Rem.	0.98363

To

To find the Exact Content of a Cask taken for the Middle Fruſtum of a Parabolick Spindle.

To twice the Square of the Bung, add once the Square of the Head, from the ſum ſubtract two fifths of the Square of the difference of Bung and Head Diameters, Multiply the Remainder by the Length. Then,

Divide by { 1077 / 882 } for { Beer / Wine } gallons.

O R,

Multiply by { .000928 / .001133 } for { Beer / Wine } gallons.

Example.

A Cask { Bung —— 31.7 / Heads —— 24.3 / Length —— 49.3 } I would know the Content in Beer and Wine gallons?

31.7
31.7
2219
317
951
1004.89
2
2009.78
590.49
2600.27
21.90
2578.37
49.3
773511
2320533
1031348
127113.641

24.3
24.3
729
972
486
590.49

... (gall.
1077) 127113(118 Beer
1941
8643
27

31.7

31.7
24.3
7.4
7.4
296
518
54.76
2
109.52

21.90 is two fifths of differ. of Squares of Bung and Heads.

127113
.000928
1016904
254226
1144017

Beer gallons 117|960864

...

882) 127113 (144 Wine gallons.
3891
3633
105

127113
.001133
381339
381339
127113
127113

Wine gallons 144|019029

The

The Uſe of Circles Areas.

To find the Quantity of Liquor remaining in a Spheroidal Cask ſtanding upon one Head, viz. *The Axe Perpendicular to the Horizon.*

FRom the Area of Bung Circle, ſubtract the Area of Head Circle, multiply the remainder by the ſquare of the Liquors ſurface diſtance from the Bung, this product divide by 3 times the ſquare of the Semi-length, and Subtract the Quotient from the Area of the Bung Circle, multiply the remainder by the diſtance of Liquors ſurface, and the product will be above or beneath half the Veſſels capacity.

Bung —— 29
Heads — 23
Length — 42
Wet inches 28

28
21
——
7 Liquors ſurface diſt. from (bung.

2.3423
1.4733
——
0.8690
49
——
78210
34760
——
4215810
——

21
21
——
21
42
——
441
3
——
1323
——

1323)

```
                 . . .
1323) 425810 ( 2.3423
       2890     .0321
        2440    ------
       ------   2.3102
        1117        7
       ------   -------
Liquor above half full 16|1714
                       -------
```

To find the Content of the Fruſtum of a Globe.

To the Area of Fruſtums Diameter, add the Area of the Altitude with one third of the ſame, multiply the ſum by half the height and you have the Content of the Fruſtum.

The Fruſtum of a Globe or riſing Crown of a Copper, the Diameter is 84.3 Inch., height 34.8 Inch., I would know the Content in Beer Gallons?

```
Inches 84.3 ------------------ 19.792
Inches 34.8 Area of Alt. ----- 3.372
1 third of the ſame ---------- 1.124
                              ---------
                              24.288
Half the height ------------- 17.4
                              ---------
                               97152
                              170016
                              24288
                              ---------
Content of the Fruſtum in Beer gall. 422|6112
                              ---------
```

The

The Uſe of Circles Areas.

To find the Content of a Cylinder. see p. 78

Multiply the Area of Cylinders Diameter by the Depth, and you have the Solid Content. (in Beer Gallons Inc. of 282 Solid Inches

A Cylinder	Diameter	78.3	I would know the Content in Beer Gallons?
	Depth	51.2	

The Area of Diameter is 17.075
51.2

34150
17075
85375

Beer gallons —— 874.2400

To find the Content of the fruſtum of a Cone cut off by a Plain parallel to the Baſe.

To the Area anſwering the Semi-Sum of the Diameters, add one third of the Area of the Semi-difference of Diameters, this laſt multiply by the Depth and you have the Content.

The Use of Circles Areas.

Example.

The Frustum of a Cone: { The greatest Diameter 79.3 / The least Diameter — 68.5 / The Depth ——— 49.7 } I would know the content in Beer gallons?

79.3
68.5
147.8

Semi-sum 73.9 — Area 15 210

10.8

Semi-difference 5.4 one third of Area 0.027

15.237
49.7
106659
137133
60948

Beer gallons 757127.89

The

The Uſe of Circles Areas.

To find the Content of the frustum of a Parabolick Conoid.

To the Area of the greateſt Diameter, add the Area of the leaſt Diameter, multiply the ſum by half the depth, and you have the Content.

Example.

		Inches.	
The lower Frustum of a Parabolick Conoid.	Greateſt diameter	79.3	I would know the Content in Beer gallons
	Leaſt diameter	68.5	
	Depth	49.7	

Area of the greateſt diameter 17.514
Area of the leaſt diameter 13.068

Sum — 30.582
24.85

152910
244656
122328
61164

Beer gallons 759196270

The Uſe of Circles Areas.

To find the Content of a Cask taken for the middle fruſtum of a Spheroid.

To the doubled Area of the Bung Circle, add the Area of the Head Circle, multiply the ſum by the Length, and you have the Content.

A Cask { Bung ——— 31.7 / Heads —— 24.3 / Length ——— 49.3 } I would know the Content in Wine Gallons?

Inches.

Area of the Bung Circle 3.4166
3.4166

Area of the Head Circle 2.0076

8.8408
16.43

265224
353632
530448
88408

Wine Gallons 145125434 4

The

The Use of Circles Areas.

To find the Content of a Cask taken for the middle Frustum of a Parabolick Spindle.

To twice the Area of the Bung Circle, add the Area of the Head Circle, from this sum subtract the Area belonging to the difference of Diameters multiplied by 0.4, multiply the Remainder by one third of the Length, and you have the Content.

Example.

A Cask { Bung —— 31.7 / Heads —— 24.3 / Length —— 49.3 } I would know the Content in Wine gallons?

3.4166
3.4166
2.0076

31.7
24.3 Sum— 8.8408

differ. of 7.4 diam. Area mult. by 0.4 is 0745

Remainder 8.7663
16 4

350652
525978
87663

Wine Gallons 143176732

TABLES

Circles Areas.

Dia.	0	.1	.2	.25	.3	.4
1	0.0028	0.0034	0.0040	0.0043	0.0047	0.0055
2	0.0111	0.0123	0.0135	0.0140	0.0147	0.0160
3	0.0251	0.0268	0.0285	0.0294	0.0303	0.0322
4	0.0446	0.0468	0.0491	0.0503	0.0515	0.0539
5	0.0696	0.0724	0.0753	0.0767	0.0782	0.0812
6	0.1003	0.1036	0.1071	0.1087	0.1105	0.1141
7	0.1365	0.1404	0.1444	0.1463	0.1484	0.1525
8	0.1782	0.1827	0.1873	0.1895	0.1919	0.1965
9	0.2256	0.2306	0.2357	0.2383	0.2409	0.2461
10	0.2785	0.2841	0.2898	0.2926	0.2955	0.3012
11	0.3370	0.3432	0.3494	0.3524	0.3556	0.3620
12	0.4011	0.4078	0.4145	0.4179	0.4214	0.4282
13	0.4707	0.4780	0.4853	0.4889	0.4927	0.5001
14	0.5459	0.5537	0.5616	0.5655	0.5695	0.5775
15	0.6266	0.6350	0.6435	0.6477	0.6520	0.6605
16	0.7130	0.7219	0.7309	0.7354	0.7400	0.7491
17	0.8049	0.8144	0.8239	0.8287	0.8336	0.8432
18	0.9024	0.9124	0.9225	0.9276	0.9327	0.9429
19	1.0054	1.0160	1.0267	1.0320	1.0374	1.0482
20	1.1140	1.1252	1.1364	1.1420	1.1477	1.1590
21	1.2282	1.2400	1.2517	1.2576	1.2636	1.2755
22	1.3480	1.3603	1.3726	1.3788	1.3850	1.3975
23	1.4733	1.4862	1.4991	1.5055	1.5120	1.5250
24	1.6042	1.6176	1.6311	1.6378	1.6446	1.6581
25	1.7407	1.7546	1.7686	1.7757	1.7827	1.7968
26	1.8827	1.8972	1.9118	1.9191	1.9264	1.9411
27	2.0303	2.0454	2.0605	2.0681	2.0757	2.0909
28	2.1835	2.1991	2.2148	2.2226	2.2306	2.2464
29	2.3423	2.3585	2.3747	2.3828	2.3910	2.4073
30	2.5066	2.5233	2.5401	2.5485	2.5570	2.5739
31	2.6765	2.6938	2.7111	2.7198	2.7285	2.7460
32	2.8519	2.8698	2.8877	2.8967	2.9057	2.9237
33	3.0330	3.0514	3.0698	3.0792	3.0884	3.1069
34	3.2196	3.2385	3.2576	3.2672	3.2766	3.2958
35	3.4117	3.4313	3.4509	3.4608	3.4705	3.4902

Circles Areas.

Dia.	.5	.6	.7	.75	.8	.9
1	0.0063	0.0071	0.0080	0.0085	0.0090	0.0101
2	0.0174	0.0188	0.0203	0.0210	0.0218	0.0234
3	0.0341	0.0361	0.0381	0.0391	0.0402	0.0424
4	0.0564	0.0589	0.0615	0.0628	0.0642	0.0669
5	0.0842	0.0873	0.0905	0.0920	0.0937	0.0969
6	0.1177	0.1213	0.1250	0.1288	0.1288	0.1326
7	0.1567	0.1609	0.1651	0.1672	0.1694	0.1738
8	0.2012	0.2060	0.2108	0.2132	0.2157	0.2206
9	0.2514	0.2567	0.2621	0.2647	0.2675	0.2730
10	0.3071	0.3129	0.3189	0.3218	0.3249	0.3309
11	0.3683	0.3749	0.3814	0.3845	0.3879	0.3945
12	0.4352	0.4422	0.4492	0.4527	0.4563	0.4635
13	0.5076	0.5151	0.5227	0.5265	0.5304	0.5381
14	0.5856	0.5937	0.6018	0.6059	0.6100	0.6181
15	0.6691	0.6778	0.6865	0.6908	0.6953	0.7041
16	0.7582	0.7675	0.7767	0.7813	0.7861	0.7955
17	0.8529	0.8627	0.8725	0.8774	0.8824	0.8924
18	0.9532	0.9635	0.9739	0.9791	0.9844	0.9949
19	1.0590	1.0699	1.0809	1.0863	1.0919	1.1029
20	1.1704	1.1819	1 1934	1.1991	1.2049	1.2166
21	1.2874	1.2994	1.3115	1.3175	1.3236	1.3358
22	1.4100	1.4225	1.4351	1.4414	1.4478	1.4605
23	1.5381	1.5512	1.5644	1.5709	1.5776	1.5909
24	1.6718	1.6854	1.6992	1.7060	1.7129	1.7268
25	1.8110	1.8252	1.8395	1.8467	1.8539	1.8683
26	1.9558	1.9706	1.9855	1.9929	2.0004	2.0153
27	2.1062	2.1216	2.1370	2.1447	2.1524	2.1679
28	2.2622	2.2781	2.2941	2.3020	2.3101	2.3261
29	2.4237	2.4402	2.4567	2.4650	2.4733	2.4899
30	2.5908	2.6079	2.6249	2.6335	2.6421	2.6592
31	2.7635	2.7811	2.7987	2.8076	2.8164	2.8341
32	2.9418	2.9599	2.9781	2.9872	2.9963	3.0146
33	3.1256	3 1443	3.1630	3.1725	3.1818	3.2007
34	3.3150	3.3342	3.3535	3.3633	3.3729	3.3923
35	3.5097	3.5299	3.5496	3.5596	3.5695	3.5895

Circles Areas.

Dia.	0	.1	.2	.25	.3	4.
36	3.6095	3.6295	3.6497	3.6599	3.6699	3.6901
37	3.8128	3.8334	3.8541	3.8646	3.8747	3.8957
38	4.0217	4.0429	4.0641	4.0749	4.0854	4.1068
39	4.2361	4.2579	4.2797	4.2907	4.3016	4.3236
40	4.4562	4.4785	4.5008	4.5121	4.5233	4.5457
41	4.6818	4.7046	4.7275	4.7390	4.7505	4.7735
42	4.9129	4.9363	4.9598	4.9715	4.9834	5.0069
43	5.1496	5.1736	5.1977	5.2099	5.2218	5.2459
44	5.3920	5.4165	5.4411	5.4534	5.4657	5.4904
45	5.6393	5.6649	5.6901	5.7026	5.7153	5.7405
46	5.8933	5.9189	5.9446	5.9575	5.9704	5.9962
47	6.1523	6.1785	6.2048	6.2179	6.2311	6.2575
48	6.4169	6.4436	6.4705	6.4839	6.4973	6.5243
49	6.6870	6.7143	6.7417	6.7554	6.7692	6.7966
50	6.9628	6.9906	7.0186	7.0325	7.0466	7.0746
51	7.2440	7.2725	7.3010	7.3152	7.3295	7.3581
52	7.5309	7.5599	7.5890	7.6034	7.6181	7.6472
53	7.8233	7.8529	7.8825	7.8973	7.9122	7.9419
54	8.1214	8.1515	8.1816	8.1967	8.2118	8.2421
55	8.4249	8.4556	8.4863	8.5016	8.5171	8 5479
56	8.7341	8.7653	8.7966	8.8122	8.8279	8.8593
57	9.0488	9.0806	9.1124	9.1283	9.1443	9.1762
58	9.3691	9.4014	9.4338	9.4500	9.4662	9.4988
59	9.6949	9.7278	9.7608	9.7772	9.7938	9.8269
60	10.0264	10.0598	10.0933	10.1100	10.1269	10.1605
61	10.3634	10.3974	10.4314	10.4484	10.4655	10.4997
62	10.7059	10.7405	10.7751	10.7924	10.8098	10.8445
63	11.0541	11.0892	11.1244	11.1420	11.1596	11.1949
64	11.4078	11.4434	11.4792	11.4970	11.5150	11.5508
65	11.7670	11.8033	11.8396	11.8577	11.8759	11.9123
66	12.1319	12.1687	12.2055	12.2239	12.2424	12.2794
67	12.5023	12.5397	12.5771	12.5958	12.6145	12.6520
68	12.8783	12.9162	12.9542	12.9731	12.9922	13.0303
69	13.2599	13.2983	13.3368	13.3561	13.3754	13.4140
70	13.6470	13.6860	13.7251	13.7446	13.7642	13.8034

Circles Areas.

Dia.	.5	.6	.7	.75	.8	.9
36	3.7104	3.7308	3.7512	3.7616	3.7717	3.7922
37	3.9165	3.9375	3.9584	3.9690	3.9795	4.0005
38	4.1282	4.1497	4.1712	4.1820	4.1928	4.2144
39	4.3456	4.3676	4.3897	4.4008	4.4117	4.4339
40	4.5683	4.5908	4.6135	4.6250	4.6362	4.6590
41	4.7966	4.8198	4.8430	4.8546	4.8662	4.8895
42	5.0306	5.0543	5.0780	5.0901	5.1019	5.1257
43	5.2701	5.2944	5.3187	5.3308	5.3430	5.3675
44	5.5152	5.5400	5.5649	5.5773	5.5898	5 6148
45	5.7659	5.7912	5.8167	5.8293	5.8421	5.8677
46	6.0221	6.0480	6.0740	6.0870	6.1000	6.1261
47	6.2839	6.3104	6.3369	6.3502	6.3635	6.3902
48	6.5513	6.5783	6.6054	6.6190	6.6325	6.6598
49	6.8242	6.8518	6.8794	6.8932	6.9072	6.9349
50	7.1027	7.1309	7.1591	7.1731	7.1873	7.2157
51	7.3868	7.4155	7.4443	7.4586	7.4731	7.5020
52	7.6764	7.7057	7.7350	7.7497	7.7644	7.7938
53	7.9717	8.0015	8.0314	8.0463	8.0612	8.0912
54	8.2724	8.3028	8.3333	8.3485	8.3638	8.3943
55	8.5788	8.6097	8.6407	8.6562	8.6718	8 7029
56	8.8907	8.9222	8.9538	8.9695	8.9854	9.0171
57	9.2082	9.2403	9.2724	9.2884	9.3046	9.3368
58	9.5313	9.5639	9.5966	9.6129	9.6293	9.6621
59	9.8600	9.8931	9.9263	9.9429	9.9596	9.9930
60	10.1942	10.2279	10.2617	10.2785	10.2955	10.3294
61	10.5339	10.5682	10.6026	10.6197	10.6370	10.6714
62	10.8793	10.9141	10.9490	10.9665	10.9840	11.0190
63	11.2302	11.2656	11.3011	11.3188	11.3366	11.3721
64	11.5867	11.6227	11.6587	11.6767	11.6947	11.7309
65	11.9488	11.9853	12.0219	12.0401	12.0585	12.0952
66	12.3164	12.3535	12.3906	12.4091	12.4278	12.4650
67	12.6896	12.7272	12.7649	12.7837	12.8027	12.8405
68	13.0684	13.1066	13.1448	13.1639	13.1831	13.2215
69	13.4527	13.4915	1.35303	13.5497	13.5691	13.6080
70	13.8426	13.8819	1.39213	13.9410	13.9607	14.0002

Circles Areas.

Dia.	0	.1	.2	.25	.3	.4
71	14.0397	14.0793	14.1189	14.1387	14.1586	14.1983
72	14.4380	14.4781	14.5183	14.5384	14.5585	14.5988
73	14.8418	14.8825	14.9232	14.9436	14.9640	15.0049
74	15.2512	15.2925	15.3338	15.3544	15.3751	15.4165
75	15.6662	15.7080	15.7499	15.7708	15.7918	15.8337
76	16.0867	16.1291	16.1715	16.1927	16.2140	16.2565
77	16.5129	16.5558	16.5988	16.6202	16.6418	16.6849
78	16.9445	16.9880	17.0316	17.0533	17.0751	17.1188
79	17.3818	17.4258	17.4699	17.4920	17.5141	17.5583
80	17.8246	17.8692	17.9139	17.9362	17.9586	18.0033
81	18.2730	18.3182	18.3634	18.3860	18.4086	18.4540
82	18.7270	18.7727	18.8185	18.8414	18.8643	18.9102
83	19.1866	19.2328	19.2791	19.3024	19.3255	19.3719
84	19.6517	19.6985	19.7454	19.7689	19.7923	19.8393
85	20.1223	20.1697	20.2172	20.2410	20.2646	20.3122
86	20.5986	20.6465	20.6945	20.7187	20.7427	20.7907
87	21.0804	21.1289	21.1775	21.2019	21.2261	21.2747
88	21.5678	21.6169	21.6660	21 6905	21.7151	21.7643
89	22.0608	22.1104	22.1600	22.1849	22.2098	22.2595
90	22.5593	22.6095	22.6597	22.6848	22.7100	22.7603
91	23.0634	23.1141	23.1649	23.1903	23.2157	23.2666
92	23.5731	23.6244	23.6757	23.7014	23 7271	23.7785
93	24.0883	24.1402	24.1920	24.2181	24.2440	24.2960
94	24 6091	24.6615	24.7140	24.7403	24.7665	24.8190
95	25.1355	25.1885	25.2415	25.2681	25.2945	25.3476
96	25.6675	25.7210	25.7745	25.8015	25.8282	25 8818
97	26.2050	26.2591	26.3133	26.3402	26.3674	26.4216
98	26.7481	26.8027	26.8574	26.8847	26.9121	26.9669
99	27.2968	27 3519	27.4072	27.4348	27.4625	27.5178
100	27.8510	27.9067	27.9625	27.9904	28.0184	28.0743
101	28.4108	28.4671	28.5234	28.5517	28.5798	28.6363
102	28.9762	29.0330	29.0899	29.1184	29.1469	29.2039
103	29.5471	29.6045	29.6620	29.6907	29.7195	29.7771
104	30.1236	30.1816	30.2396	30.2686	30.2977	30.3558
105	30.7057	30.7642	30.8228	30.8521	30.8814	30.9401

Circles Areas.

Dia.	.5	.6	.7	.75	.8	.9
71	14.2381	14.2780	14.3179	14.3378	14.3579	14.3979
72	14.6392	14.6796	14.7201	14.7403	14.7606	14.8012
73	15.0458	15.0868	15.1278	15.1483	15.1689	15.2100
74	15.4580	15.4995	15.5411	15.5619	15.5827	15.6244
75	15.8758	15.9178	15.9600	15.9810	16.0022	16.0444
76	16.2991	16.3417	16.3844	16.4058	16.4272	16.4700
77	16.7280	16.7712	16.8145	16.8361	16.8578	16.9011
78	17.1625	17.2062	17.2500	17.2719	17.2939	17.3378
79	17.6025	17.6468	17.6912	17.7134	17.7356	17.7801
80	18.0481	18.0930	18.1379	18.1604	18.1829	18.2280
81	18.4993	18 5448	18.5902	18.6130	18.6358	18.6814
82	18.9561	19.0021	19.0481	19.0712	19.0942	19.1403
83	19.4184	19.4650	19.5115	19.5349	19.5582	19.6049
84	19.8863	19.9334	19.9806	20.0043	20.0278	20.0750
85	20.3598	20.4074	20.4551	20.4791	20.5029	20.5507
86	20.8388	20.8870	20.9353	20.9596	20.9836	21.0320
87	21.3234	21.3722	21 4210	21.4456	21.4699	21.5188
88	21.8136	21.8629	21.9123	21.9370	21.9617	22.0112
89	22.3093	22.3592	22.4092	22.4341	22.4592	22.5092
90	22.8107	22.8611	22.9116	22.9369	22.9621	23.0128
91	23.3176	23.3685	23.4196	23.4452	23.4707	23.5219
92	23.8300	23.8816	23.9332	23.9570	23.9848	24.0366
93	24.3480	24.4001	24.4523	24.4785	24.5045	24.5568
94	24.8716	24.9243	24.9770	25.0035	25.0298	25.0826
95	25.4008	25.4540	25.5073	25.5341	25.5606	25.6140
96	25.9355	25.9893	26.0432	26.0702	26.0971	26.1510
97	26.4759	26.5302	26.5846	26.6118	26.6390	26.6935
98	27.0217	27.0766	27.1316	27.1591	27.1866	27.2416
99	27.5732	27.6286	27.6841	27.7119	27.7397	27.7953
100	28.1302	28.1862	28.2423	28.2704	28.2984	28.3546
101	28.6928	28.7494	28.8060	28.8344	28.8627	28.9194
102	29.2610	29.3181	29.3753	29.4038	29.4325	29.4898
103	29.8347	29.8924	29.9501	29.9789	30.0079	30.0657
104	30.4140	30.4722	30.5305	30.5596	30.5889	30.6473
105	30.9989	31 0577	31.1165	31.1459	31.1754	31.2344

Circles Areas.

Dia.	0	.1	.2	.25	.3	.4
106	31.2934	31.3525	31.4116	31.4411	31.4708	31.5300
107	31.8866	31.9462	32.0059	32.0357	32.0657	32.1255
108	32.4854	32.5456	32.6058	32.6359	32.6661	32.7265
109	33.0898	33.1505	33.2113	33.2417	33.2722	33.3331
110	33.6997	33.7610	33.8224	33.8530	33.8838	33.9452
111	34.3152	34.3771	34.4390	34.4699	34.5010	34.5630
112	34.9363	34.9987	35.0612	35.0924	35.1237	35.1863
113	35.5629	35.6259	35.6889	35.7204	35.7520	35.8152
114	36.1952	36.2587	36.3222	36.3540	36.3859	36.4496
115	36.8329	36.8970	36.9612	36.9932	37.0254	37.0896
116	37.4763	37.5409	37.6056	37.6380	37.6704	37.7352
117	38.1252	38.1904	38.2557	38.2883	38.3210	38.3864
118	38.7797	38.8455	38.9113	38.9442	38.9772	38.0431
119	39.4398	39.5061	39.5725	39.6056	39.6389	39.7054
120	40.1054	40.1723	40.2392	40.2727	40.3062	40.3733
121	40.7766	40.8441	40.9116	40.9453	40.9791	41.0467
122	41.4534	41.5214	41.5895	41.6234	41.6575	41.7257
123	42.1358	42.2043	42.2729	42.3072	42.3416	42.4103
124	42.8237	42.8928	42.9619	42.9965	43.0312	43.1004
125	43.5172	43.5868	43.6566	43.6914	43.7263	43.7961
126	44.2162	44.2865	44.3567	44.3918	44.4271	44.4974
127	44.9209	44.9916	45.0625	45.0979	45.1336	45.2043
128	45.6311	45.7024	45.7738	45.8095	45.8452	45.9167
129	46.3468	46.4187	46.4907	46.5266	46.5627	46.6347
130	47.0682	47.1406	47.2131	47.2493	47.2857	47.3583
131	47.7951	47.8681	47.9412	47.9777	48.0143	48.0874
132	48.5276	48.6011	48.6747	48.7115	48.7484	48.8221
133	49.2656	49.3397	49.4139	49.4510	49.4881	49.5624
134	50.0093	50.0839	50.1586	50.1960	50.2334	50.3083
135	50.7584	50.8337	50.9090	55.9466	50.9843	51.0597
136	51.5132	51.5890	51.6648	51.7027	51.7407	51.8167
137	52.2735	52.3499	52.4263	52.4644	52.5027	52.5791
138	53.0394	53.1163	53.1933	53.2317	53.2703	53.3474
139	53 8109	53.8884	53.9659	54.0046	54.0434	54.1211
140	54.5880	54.6660	54.7440	54.7830	54.8222	54.9003

Circles Areas.

Dia.	.5	.6	.7	.75	.8	.9
106	31.5893	31.6487	31.7081	31.7377	31.7675	31.8270
107	32.1853	32.2452	32.3052	32.3351	32.3652	32.4253
108	32.7869	32.8474	32.9079	32.9381	32.9685	33.0291
109	33.3940	33.4551	33.5161	33.5467	33.5773	33.6385
110	34.0068	34.0683	34.1300	34.1608	34.1917	34.2534
111	34.6251	34.6872	34.7494	34.7805	34.8116	34.8739
112	35.2489	35.3116	35.3744	35.4057	35.4372	35.5000
113	35.8784	35.9416	36.0049	36.0365	36.0683	36.1317
114	36.5134	36.5772	36.6410	36.6729	36.7049	36.7689
115	37.1539	37.2182	37.2827	37.3149	37.3472	37.4117
116	37.8001	37.8650	37.9300	37.9624	37.9950	38.0601
117	38.4518	38.5173	38.5828	38.6156	38.6484	38.7140
118	39.1091	39.1751	39.2412	39.2742	39.3073	39.3735
119	39.7719	39.8385	39.9052	39.9385	39.9719	40.0386
120	40.4403	40.5075	40.5747	40.6083	40.6420	40.7093
121	41.1143	41.1820	41.2498	41.2837	41.3176	41.3855
122	41.7939	41.8622	41.9305	41.9646	41.9989	42.0673
123	42.4790	42.5479	42.6167	42.6512	42.6857	42.7547
124	43.1697	43.2391	43.3086	43.3433	43.3780	43.4476
125	43.8660	43.9360	44.0059	44.0409	44.0760	44.1461
126	44.5679	44.6384	44.7089	44.7442	44.7795	44.8502
127	45.2753	45.3463	45.4174	45.4530	45.4886	45.5598
128	45.9883	46.0599	46.1315	46.1673	46.2032	46.2750
129	46.7068	46.7790	46.8512	46.8873	46.9235	46.9958
130	47.4309	47.5037	47.5764	47.6128	47.6493	47.7222
131	48.1606	48.2339	48.3073	48.3439	48.3806	48.4541
132	48.8959	48.9697	49.0436	49.0805	49.1176	49.1916
133	49.6367	49.7111	49.7856	49.8228	49.8601	49.9346
134	50.3832	50.4581	50.5331	50.5706	50.6082	50.6833
135	51.1351	51.2106	51.2862	51.3239	51.3618	51.4375
136	51.8922	51.9687	52.0449	52.0829	52.1210	52.1973
137	52.6558	52.7324	52.8091	52.8474	52.8858	52.9626
138	53.4245	53.5017	53.5789	53.6175	53.6562	53.7335
139	54.9187	54.2765	54.3543	54.3931	54.4321	54.5100
140	54.9786	55.0569	55.1352	55.1743	55.2136	55.2921

 1 Wine Gall. 231 Inches

Circles Areas in Wine-Gallons.

Dia.	0	.1	.2	.25	.3	.4
1	0.0034	0.0041	0.0049	0.0053	0.0057	0.0067
2	0.0136	0.0149	0.0165	0.0173	0.0180	0.0196
3	0.0306	0.0326	0.0347	0.0359	0.0369	0.0393
4	0.0544	0.0572	0.0600	0.0615	0.0629	0.0659
5	0.0880	0.0885	0.0919	0.0937	0.0955	0.0991
6	0.1224	0.1265	0.1307	0.1328	0.1350	0.1393
7	0.1666	0.1714	0.1763	0.1787	0.1812	0.1862
8	0.2176	0.2231	0.2287	0.2315	0.2343	0.2400
9	0.2754	0.2815	0.2877	0.2910	0.2944	0.3004
10	0.3400	0.3468	0.3537	0.3572	0.3607	0.3678
11	0.4114	0.4189	0.4265	0.4303	0.4341	0.4418
12	0.4896	0.4978	0.5061	0.5102	0.5144	0.5228
13	0.5746	0.5835	0.5925	0.5970	0.6055	0.6106
14	0.6664	0.6760	0.6856	0.6904	0.6953	0.7051
15	0.7650	0.7752	0.7855	0.790	0.7959	0.8064
16	0.8704	0.8813	0.8923	0.8978	0.9034	0.9145
17	0.9826	0.9942	1.0059	1.0117	1.0176	1.0294
18	1.1016	1.1139	1.1263	1.1325	1.1386	1.1512
19	1.2274	1.2404	1.2534	1.2600	1.2665	1.2797
20	1.3600	1.3736	1.3873	1.3942	1.4011	1.4149
21	1.4995	1.5137	1.5281	1.5353	1.5425	1.5570
22	1.6456	1.6606	1.6757	1.6832	1.6908	1.7060
23	1.7986	1.8142	1.8299	1.8378	1.8457	1.8617
24	1.9584	1.9747	1.9911	1.9994	2.0076	2.0242
25	2.1250	2.1420	2.1591	2.1677	2.1763	2.1936
26	2.2984	2.3161	2.3339	2.3428	2.3517	2.3697
27	2.4786	2.4970	2.5155	2.5247	2.5340	2.5526
28	2.6656	2.6847	2.7038	2.7134	2.7230	2.7423
29	2.8594	2.8791	2.8989	2.9089	2.9188	2.9388
30	3.0600	3.0804	3.1009	3.1112	3.1215	3.1422
31	3.2674	3.2885	3.3097	3.3203	3.3309	3.3522
32	3.4816	3.5034	3.5253	3.5362	3.5472	3.5692
33	3.7026	3.7251	3.7476	3.7589	3.7702	3.7929
34	3.9304	3.9536	3.9768	3.9885	4.0001	4.0235
35	4.1650	4.1888	4.2127	4.2247	4.2367	4.2608

Circles Areas in Wine-Gallons.

Dia.	.5	.6	.7	.75	.8	.9
1	0.0077	0.0087	0.0098	0.0104	0.0110	0.0123
2	0.0213	0.0230	0.0248	0.0258	0.0267	0.0286
3	0.0416	0.0440	0.0465	0.0478	0.0491	0.0517
4	0.0689	0.0720	0.0751	0.0767	0.0783	0.0816
5	0.1029	0.1067	0.1106	0.1124	0.1144	0.1184
6	0.1437	0.1482	0.1527	0.1549	0.1573	0.1619
7	0.1913	0.1964	0.2016	0.2042	0.2069	0.2122
8	0.2457	0.2515	0.2574	0.2603	0.2633	0.2693
9	0.3069	0.3134	0.3199	0.3233	0.3265	0.3332
10	0.3749	0.3821	0.3893	0.3929	0.3966	0.4040
11	0.4497	0.4576	0.4655	0.4694	0.4735	0.4815
12	0.5313	0.5398	0.5484	0.5527	0.5571	0.5658
13	0.6197	0.6289	0.6382	0.6428	0.6475	0.6569
14	0.7149	0.7248	0.7348	0.7398	0.7448	0.7549
15	0.8169	0.8275	0.8381	0.8434	0.8488	0.8596
16	0.9257	0.9369	0.9482	0.9539	0.9596	0.9711
17	1.0413	1.0532	1.0652	1.0712	1.0773	1.0894
18	1.1637	1.1763	1.1890	1.1953	1.2017	1.2145
19	1.2929	1.3062	1.3195	1.3262	1.3329	1.3464
20	1.4289	1.4428	1.4569	1.4339	1.4710	1.4852
21	1.5716	1.5862	1.6009	1.6084	1.6157	1.6306
22	1.7213	1.7366	1.7520	1.7597	1.7675	1.7830
23	1.8777	1.8937	1.9098	1.9179	1.9259	1.9421
24	2.0409	2.0576	2.0744	2.0828	2.0912	2.1081
25	2.2109	2.2283	2.2457	2.2544	2.2632	2.2808
26	2.3877	2.4057	2.4238	2.4329	2.4420	2.4603
27	2.5713	2.5900	2.6088	2.6182	2.6277	2.6466
28	2.7617	2.7811	2.8006	2.8104	2.8201	2.8397
29	2.9589	2.9789	2.9992	3.0093	3.0194	3.0396
30	3.1629	3.1837	3.2045	3.2149	3.2254	3.2464
31	3.3736	3.3951	3.4166	3.4274	3.4382	3.4599
32	3.5913	3.6134	3.6356	3.6467	3.6578	3.6802
33	3.8157	3.8385	3.8614	3.8729	3.8843	3.9073
34	4.0469	4.0704	4.0940	4.1058	4.1176	4.1413
35	4.2849	4.3091	4.3333	4.3454	4.3576	4.3820

Circles Areas in Wine-Gallons.

Dia.	0	.1	.2	.25	.3	.4
36	4.4064	4.4309	4.4555	4.4679	4.4802	4.5949
37	4.6546	4.6798	4.7051	4.7178	4.7304	4.7558
38	4.9096	4.9355	4.9614	4.9744	4.9874	5.0135
39	5.1714	5.1980	5.2246	5.2380	5.2513	5.2781
40	5.4400	5.4673	5.4945	5.5083	5.5220	5.5494
41	5.7154	5.7434	5.7713	5.7854	5.7994	5.8275
42	5.9976	6.0262	6.0549	6.0692	6.0836	6.1124
43	6.2866	6.3159	6.3452	6.3599	6.3746	6.4041
44	6.5824	6.6124	6.6424	6.6574	6.6725	6.7027
45	6.8850	6.9156	6.9463	6.9617	6.9771	7.0079
46	7.1944	7.2257	7.2571	7.2728	7.2886	7.3201
47	7.5106	7.5426	7.5747	7.5908	7.6068	7.6390
48	7.8336	7.8663	7.8990	7.9154	7.9318	7.9647
49	8.1634	8.1968	8.2302	8.2469	8.2637	8.2973
50	8.5000	8.5340	8.5681	8.5852	8.6023	8.6366
51	8.8433	8.8781	8.9129	8.9304	8.9478	8.9827
52	9.1936	9.2290	9.2645	9.2823	9.3000	9.3356
53	9.5506	9.5867	9.6228	9.6409	9.6590	9.6953
54	9.9144	9.9512	9.9880	10.0065	10.0249	10.0619
55	10.2850	10.3224	10.3599	10.3787	10.3975	10.4352
56	10.6624	10.7005	10.7387	10.7579	10.7770	10.8153
57	11.0466	11.0854	11.1243	11.1437	11.1632	11.2022
58	11.4376	11.4771	11.5166	11.5364	11.5562	11.5959
59	11.8354	11.8755	11.9157	11.9359	11.9560	11.9964
60	12.2400	12.2808	12.3217	12.3422	12.3627	12.4038

Circles Areas in Wine-Gallons.

Dia.	.5	.6	.7	.75	.8	.9
36	4.5297	4.5545	4.5794	4.5919	4.6044	4.6295
37	4.7813	4.8068	4.8324	4.8452	4.8581	4.8838
38	5.0397	5.0659	5.0922	5.1054	5.1185	5.1449
39	5.3049	5.3318	5.3588	5.3723	5.3858	5.4128
40	5.5769	5.6044	5.6320	5.6459	5.6597	5.6875
41	5.8557	5.8840	5.9123	5.9265	5.9407	5.9691
42	6.1413	6.1702	6.1992	6.2138	6.2283	6.2574
43	6.4337	6.4633	6.4930	6.5079	6.5227	6.5525
44	6.7329	6.7632	6.7935	6.8089	6.8239	6.8544
45	7.0389	7.0698	7.1009	7.1165	7.1320	7.1632
46	7.3517	7.3834	7.4151	7.4310	7.4469	7.4787
47	7.6713	7.7036	7.7360	7.7522	7.7685	7.8010
48	7.9977	8.0307	8.0638	8.0804	8.0965	8.1301
49	8.3309	8.3649	8.3984	8.4153	8.4322	8.4661
50	8.6709	8.7053	8.7397	8.7570	8.7742	8.8088
51	9.0177	9.0527	9.0879	9.1055	9.1231	9.1583
52	9.3713	9.4070	9.4428	9.4607	9.4787	9.5146
53	9.7317	9.7681	9.8046	9.8229	9.8411	9.8777
54	10.0989	10.1360	10.1731	10.1917	10.2103	10 2476
55	10.4249	10.5107	10.5485	10.5674	10.5864	10.6244
56	10.8537	10.8922	10.9307	10.9500	10.9693	11.0079
57	11.2413	11.2804	11.3196	11.3393	11.3589	11.3982
58	11.6357	11.6755	11.7154	11.7354	11.7553	11.7953
59	12.0369	12.0774	12.1180	12.1383	12.1586	12.1993
60	12.4449	12.4861	12.5273	12.5480	12.5686	12.6100

Problem 21.

To find the Content of the lower Fruſtum of an Elliptick Conoid cut off by a Plain parallel to the Baſe.

TO the Rectangle of the Top Diameters, add the Rectangle of bottom Diameters, multiply the ſum by the Depth. Then,

Divide by $\left\{\begin{matrix}718\\588\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ Gallons.

O R,

Multiply by $\left\{\begin{matrix}.0013925\\.0017\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ Gallons.

Example.

The Lower Fruſtum of an Elliptick Conoid.

Greateſt Diameter at bottom—87
Leaſt Diameter at bottom——58
Greateſt Diameter at Top——75
Leaſt Diameter at Top——50
Depth——47

I would know the Fruſtums Content in Beer and Wine gallons?

87

87
58
696
435
5046
3750
8796
47
61572
35184

75
50
3750

718) 413412 (575 Beer gallons.
5441
4152
562

413412
.00139
3720708
1240236
413412
Beer gallons. 574164268

588) 413412 (703 Wine gallons.
1812
48

413412
. 0017

2893884
413412

Wine gallons. 70218004

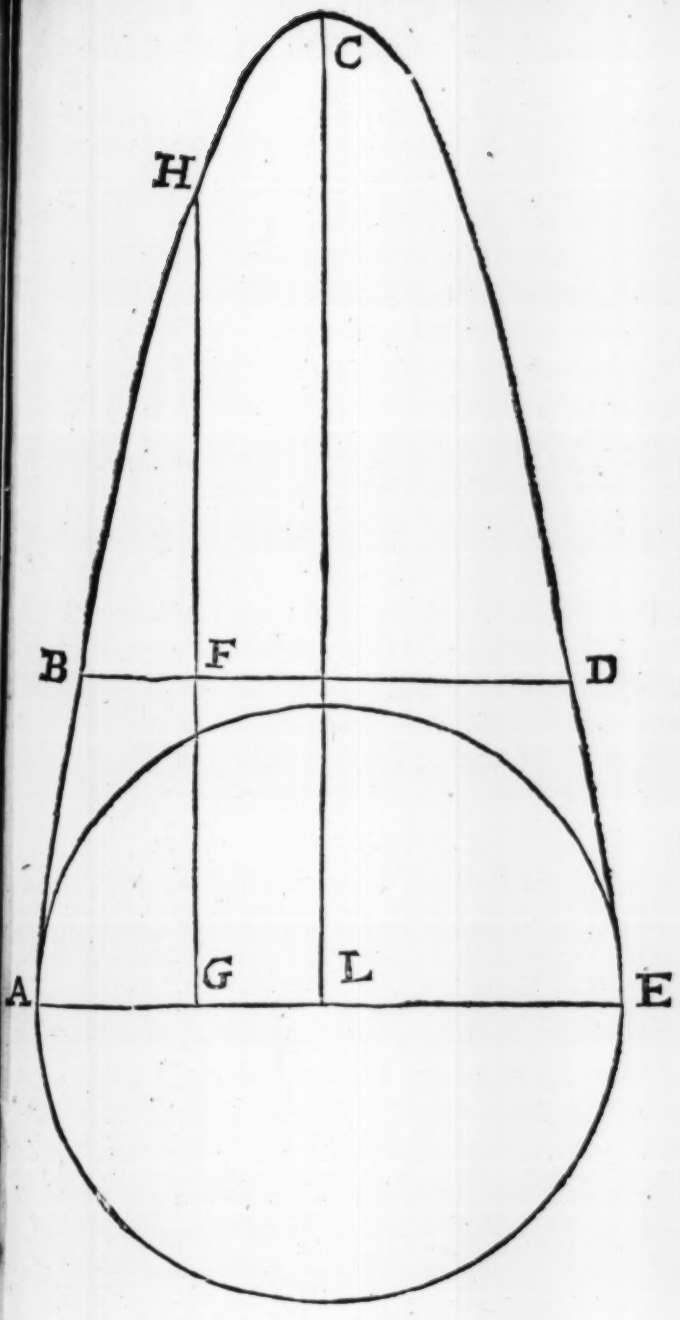
Problem 22.

If the lower Fruſtum of a Parabolick Conoid be cut off by a plain Parallel to the Axe, I would know the parts cut off.

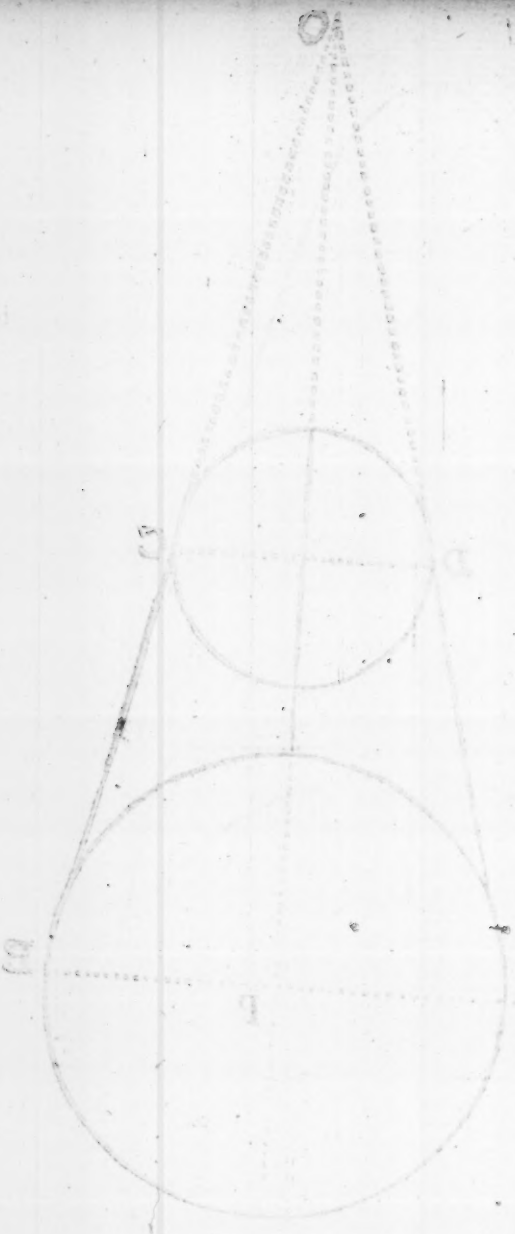
LEt (ABDE) the Fruſtum of a Parabolick Conoid be cut off by a Plain (FG) Parallel to the Axe (CL), I would know the part cut off (BFGA)?

Given { AE } Diameter { 92 } { BD } { 84 } I would know the ſecond Fruſtum (BFGA)?
{ AG Verſed Sine 31 }
{ FG the Depth—49 }

To find the Axe (CL) of the Parabolick Conoid: multiply the Square of (AE), by (FG), Divide this Product by the difference of the Square of (AE) and (BD), and you have the Axe (CL) 294. inches. Multiply (GE), by 4 times (AG), Divide that Product by (AE), and the Quotient will be 82.2 inches, a Verſed Sine of Circles Segment, when the Circles Diameter is (AE) 92 inches; by which Diameter and Verſed Sine the Area of Circles Segment will be found 6264, find the Area of a Circles Segment



Page 92. Problem 22.


O
C
D
B
A
P

ment when the diameter is (AE) 92 inches, and Verſed Sine (AG) 31 inches, it brings out 1968. From 8 times this laſt Segment, ſubtract the former Segment, multiply the Remainder by (LC), and take the $\frac{1}{12}$ of the Product, and you have the Solidity of (AHG) 232260 inches.

Subtract the Semi-difference of (AE) and (BD) from (AG,) the Remainder will be (BF) 27 inches. Take (FG) from (CL) and the Remainder will be (CP,) 245 inches, multiply (FD) 57 inches by 4 times (BF), and that divide by (FD) and the Quotient will be 73.3. A Verſed Sine of a Circle when the Diameter (BD) is 84 inch. By the ſaid Diameter and Verſed Sine you'l find the Area of Circles Segment 5130 inches, find alſo the Area 1538 inches of Circles Segment when the Diameter is (BD) 84 inches, and (BF) the Verſed Sine 27, from 8 times the laſt Segments Area, ſubtract the preceding Segments Area, multiply the Remainder by (CP) 245 inches $\frac{1}{12}$ of the Product will be the Solidity of (BHF) 146469 inches.

From (AHG), ſubtract (BHF), the Remainder will be the Solidity of (BFGA) 85791 inches Cubical Q E I.

Suppoſe this Problem had been the lower Fruſtum of a Cone re-ſected by a Plain Parallel to the Axe: I would know the Fruſtum (BFGA)?

Firſt, Find the fruſtum (BFGA) of a Parabolick Conoid as above, Then 'twill be *prope verum*

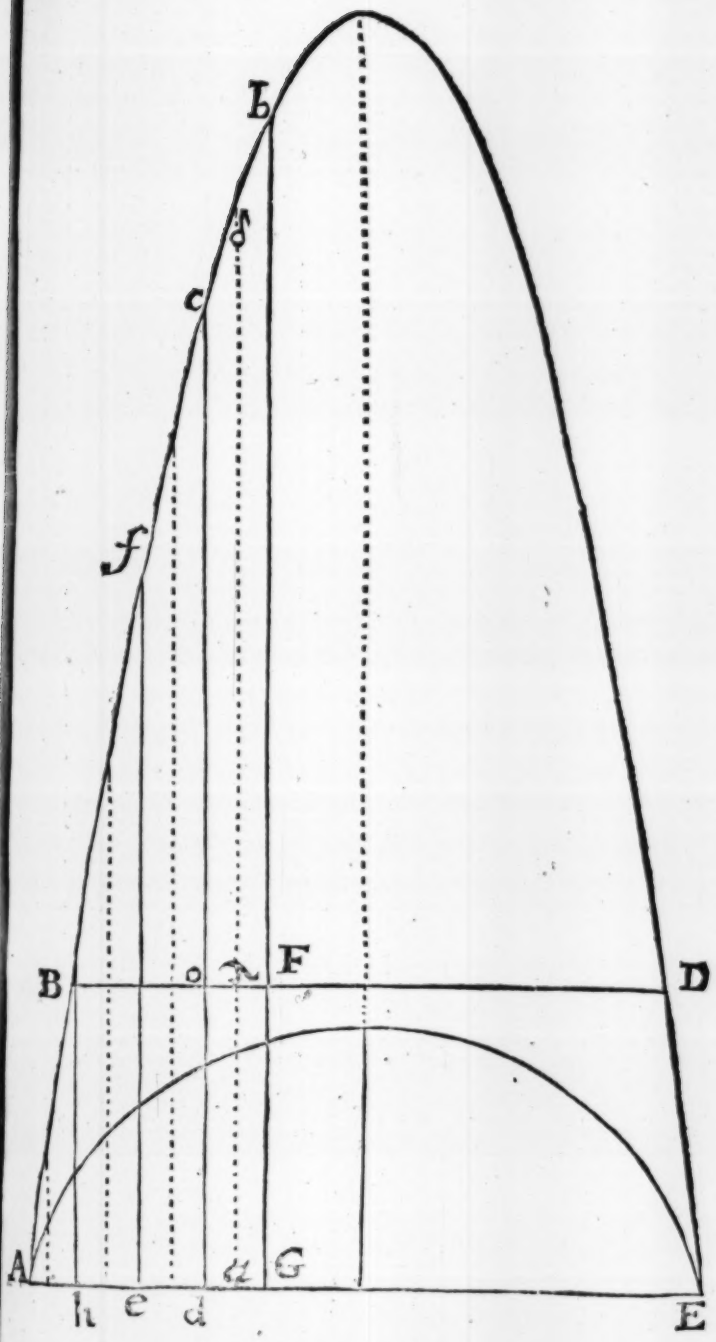
As the Treple of Sum of Squares of (AE) and (BD) 47460, is to the ſquare of ſum of (AE) and (BD) leſs by their Rectangle and Remainder doubled? So is (BFGA) 85791, fruſtum of Parabolick Conoid, to (BFGA) fruſtum of Cone 85673 inches Cubical.

To

To find the Solidity of the preceding fruſtum (BFGA) *of a Parabolick Conoid: By finding the Sum of all the Slices cut off Parallel to the Axe of the ſaid fruſtum.*

Let { Diameter AE —— 94 / Diameter BD —— 84 / Depth — FG —— 49 / Verſed Sine AG —— 19 / And (EG) will be —— 75 } I would know the Solidity of (BFGA)?

Let there be taken ſlices of this Parabolick Conoid cut Parallel to the Axe, as (Gbcd) dcfe) efgh) hgBi) each of (1) (2) (3) (4), &c. inches thickneſs (but the thinner the better). Here we ſuppoſe each 4 inches thick. Firſt find the Right Sine or loweſt Ordinate, and (α ♂) the Altitude of Parabola in the middle of the firſt ſlice, to (EG) I add (2), which is the half of (4), and from (AG) I ſubtract 2, (which is the half of the ſaid (4), the ſum I multiply by the Remainder, *viz.* I multiply (αE) by (αA) and Extract the ſquare Root of the Product for the right Sine in the middle of the firſt ſlice. Multiply alſo the ſaid Product by the depth (FG) of the fruſtum, this laſt divide by one fourth of the difference of the ſquares of (AE) and (BD), and the Quotient will be (α ♂) the Axe of the Parabola in the middle of the firſt ſlice. Multiply the ſaid Axe by the preceding right ſine by four thirds and 4 (the thickneſs of the ſlice) and you have the whole ſlice (Gbcd). From (α ♂), ſubtract (FG) or (α λ), and the Remainder will be (λ ♂), the Axe of the upper Parabola. Then ſay as (α ♂), to the above found Rectangle of (αE) αA): ſo is (♂ λ) to a number whoſe ſquare Root will be a right Sine or loweſt Ordinate of the upper Parabola when the Verſed Sine is (B λ). Multiply this right Sine by (♂ λ) by four thirds and by 4 the thickneſs of the ſlice), and you have



This belongs to Page 94.

have the ſlice (F b c o) which ſubducted from the before found ſlice (G b c d) leaves (G F o d) the ſlice of the Fruſtum of a Parabolick Conoid. By the like operation you may find every of the other ſlices; and the ſum of all will be the ſolidity of (ABGF) the fruſtum ſought.

An Example of the firſt Slice.

75=EG 19=AG
2 2
77 17
17
539
77
1309 Rectangle of (a E) and (a A.)

8(0
x (0
4 379(7
. . . .(6
x3ø9øøøø (36.18 ſquare Root is the right Sine in
3662x28 the middle of the firſt ſlice.
772

1309
49
11781
5236
445) 64141 (144 1 is (a ſ) Axe of the whole Parabola
1964 in the middle of the firſt ſlice.
1841
610

94
94
376
846
8836
7056
1780

84
84
336
672
7056

445 is one fourth of difference of ſquares of (AE) and (BD).

144.1
36.18
11528
1441
8646
4323
5213.538
4
20854.152
one third is 6951.384
4
27805.536 ſlice (G b c d).

144.1
49
95.1 (λ ∂)

As

As 144.1 —— to 1309 — ſo — 95.1

95.1

1309
6545
11781

144.1) 124485.9 (863.8000
9205
5599
12760
1232

5(0
2 3(2
4 2 1(7
..(9

863.8000 (29.39 Root, is the Right ſine
249 8369 when Verſed Sine is (Bλ.)
558

29.39
95.1

2939
14695
26451

2794.989
4

11179.956

3726.652
4

14906.608 is (Fbco)

From

From 27805.536 ſlice (G b c d.)

Take 14906.608 ſlice (F b c o.)

Reſts 12898.928 (G F o d) the Fruſtum ſlice.

To find any Diameter of a Spheroidal Cask by having the Bung, Head, Length, and the Diſtance of required Diameters from the Bung, without knowing the Spheroids Axe.

FRom the ſquare of the Length, ſubtract the ſquare of the doubled diſtance from the Bung, multiply the Remainder by the ſquare of the Bung, this add to the ſquare of the Head, multiplyed into the ſquare of the doubled diſtance from the Bung, Divide the ſquare Root of the laſt by the length, and you have the Diameter ſought.

Example.

A Spheroidal Cask { Bung —— 29, Heads —— 23, Length ——42 } I would know the Diameter?
Diſt. of required diam. from Bung- 7

14 doubled diſtance from the Bung.

14	29
	29
56	
14	261
	58
196	
	841

```
  23
  23
 ----
  69
 46
 ----
 529          42
 196          42
 ----        ----
 3174         84
4761         168
529         ----
------       1764
103684        196
------       ----
             1568
              841
             ----
             1568
            6272
           12544
           -------
           1318688
            103684
           -------
           1422372
           -------
```

```
 (15
 2162(08   42)
 . . . . .   . . .
 1422372 00 (1192.6 (28 39 diameter at the
 1212 9824     352      given distance from
   23328       166      the Bung.
     2         400
               ----
                 22
               ----
                 O 2
```

Sup-

Suppose a Cask representing the Middle frustum of a Parabolick Spindle, standing upon one Head.

Given { Bung —— 29 / Head —— 23 / Length —— 42 / Inches Wet - 28 } I would know the Diameter of Liquors surface, without finding the Axe of the Parabolick Spindle.

Multiply the Rectangle of Dry and Wet inches by four times the difference of the Bung and Head Diameters, Divide the Product by the square of the Length, this add to the Head Diameter, and the Sum will be the Diameter of Liquors surface.

28 — 6 difference of Diameters.
14 — 4

112 — 24
28

392
24

1568
784

1764)9408 (5.33
5880
5880

588

42
42

84
168

1764

23
5.33

28.33 diameter of Liquors Surface.

The

The Uſe of the Line of Numbers.

THE Line of Numbers is nothing elſe but the Logarithms, projected upon a Line, by a Scale of Equal parts, and is thus reckoned. If the firſt (1) ſtand for one, the next (1) will be 10, and the third (1) will be 100, *&c.* and the grand Diviſions betwixt 1 and 10 will be each 1, as the grand Diviſions betwixt 10 and 100 will be each 10; theſe grand Diviſions are each ſubdivided into 10 parts and are Tenths if the whole Number is betwixt (1) and (10), and are whole Numbers if betwixt 10 and 100, and Tens each if the Number is betwixt 100 and 1000, *&c.*

To Multiply by the Line of Numbers.

It will be As 1, to the Multiplier: So is the Multiplicand, to the Product.

Multiply 75 by 3, the Product is 225.

To Divide by the Line of Numbers.

It will be As the Diviſor, to 1: So is the Dividend to the Quotient.

Divide 195 by 5, the Quotient is 39.

The Rule of Three.

As the Firſt Number, to the Second: So is the Third Number to the Fourth Number.

If 5 Chald. coſt 7 l. What coſt 73 Chald. *Facit* 102 l.

The

The Uſe of the Line of Numbers.

To find the Content of a Cylinder by the Line of Numbers.

ALe Gage, *viz.* a g is 18.95, and is the ſquare Root of 359.

Wine Gage, *viz.* w g is 17.15 and is the ſquare Root of 294.

Extend your Compaſſes from the Gage Point to the Diameter; the ſame Extent twice turn'd over the ſame way from the Length or Depth, falls upon the Content in Beer or Wine Gallons according to the Gage Point.

inches.

A Cylinder { Diameter —— 36.3 } I would know the Content in Beer Gallons?
{ Height ——— 47.6 }

The Extent from 18.95 the a g, to the Diameter 36.3 inches, will reach twice turned over from 47 6 inches the Height, to 174.7 gallons the Content in Beer.

To find the Content of a Cask.

FIrſt find the Mean Diameter: or reduce the Cask to a Cylinder. Take the difference of Diameters, multiply the Remainder by 07, this Product add to the Head Diameter, and you have the Mean Diameter.

The

The Use of the Line of Numbers.

Example.

		Inches.	
A Cask	Bung	28.3	I would know the Content in Wine gallons?
	Heads	23.7	
	Length	46.4	

28.3
23.7

4.6
0.7

3.22
23.7

Reduced to a Cylind. 26.92 Mean Diameter.

The Extent from (w g) 17.15, to 26.9 inch. the mean Diameter, will reach the same way twice turn'd over from the Length 46.4; to the Content 114.1 Wine Gallons.

Another Method to find the Mean Diameter.

Set the Bung down twice, the Head once, Divide the Sum by 3 and the Quotient will be the mean Diameter.

28.3
28.3
23 7

Sum — 80.3

one third of the Sum will be 26 8 the mean Diameter.

The

The Uſe of the Line of Numbers.

The Extent from (w g) 17.15, to 26.8 inches the mean Diameter will reach the ſame way twice turned over from the Length 46.4 inches, falls upon the Content 113.3 gall. of Wine.

The Joint Uſe of the Line of Numbers and Segments on the Four-foot Rule, for finding the Liquor Remaining or drawn forth in a Lying Cask.

BUng 28.3 inches, contains 114 gallons, If 19 inches be Wet, then 9.3 inches will be dry, I would know the wet and dry gallons?

Extend your Compaſſes from the Bung-Diameter, to the wet or dry inches; the ſame Extent will reach from 100, to the fourth Number upon the Segments. Again, Extend your Compaſſes from 100 to the ſaid fourth Number counted on Numbers; the ſame Extent will reach from the whole Content of the Veſſel to the wet or dry Gallons according to what you took at firſt.

Extend your Compaſſes from 28.3 inches to 19; the ſame reacheth from 100 to 73.5 on Segments which is the

the fourth Number. Again, Extend from 100 to 73.5 on Numbers; the ſame Extent will reach from 114 gallons, to the wet gallons 83.5. Extend your Compaſſes from 28.3 inches, to 9.3; the ſame Extent will reach from 100, to 27 on the Segments. Again, Extend from 100 to 27 on the Numbers, that Extent will reach from 114 on the Numbers to the dry gallons 30.5.

The Uſe of the Sliding Rule.

IN this Rule a Double Line of Numbers, Anſwers a Double Line of Numbers; a Single Line of Numbers Anſwers a Double Line of Numbers; and alſo a Single Line of Numbers Anſwers a Treple Line of Numbers, *&c.*

The Uſe of the Double Line, Anſwering the Double Line of Numbers.

TO Multiply by the Double Line of Numbers Anſwering a Double Line, 'twill be

As 1, to the Multiplier; ſo is the Multiplicand, to the Product.

Multiply 56 by 5, the Product is 280.

To Divide by the ſaid Lines of Numbers, 'twill be

As the Diviſor to 1; ſo is the Dividend to the Quotient.

Divide 189 by 7, the Quotient will be 27.

To perform the Rule of Three by the ſaid Line, 'twill be

As the firſt Number to the Second: So is the Third Number to the Fourth.

Example.

If 34 Coſt 67: What Coſt 78. *Facit* 153.

The Uſe of the Double Line of Numbers Anſwering the Single Line *of Numbers.*

To find the Content of a Cylinder.

Put the (w g) or (a g) on Root, to the Length on Square; then againſt the Diameter on Root, Anſwers the Content on Square, whether Wine-gallons or Ale-gallons.

A Cylinder { Diameter ——— 36.3 } I would know
{ The Length or Depth 47.6 } the Content in Beer gallons?

Put (a g) on the Root, to 47.6 on the Square; then againſt 36.3 on the Root, Anſwers 174 gallons on the Square.

To

To find the Content of a Cask by the Sliding Rule.

A Veſſel { Bung —— 28.3 / Heads —— 23.7 / Length —— 46.4 } I would know the Content in Wine gallons?

Mean Diameter before was found 26.9 inches. Then,

Put (w g) on the Root, to 46.4 inches the Length on the Square; then againſt 26.9 inches the Mean Diameter on the Root, Anſwers 114 Wine-gallons the Content on the Square.

The Uſe of the Double Line of Numbers, Anſwering a Double Line of Numbers, together with a Double Line of Numbers Anſwering a Line of Segments.

To find the Remaining Liquor or Vacuity of a Lying Cask.

PUt the Bung Diameter on the ſecond Numbers, to the Wet or Dry inches on the firſt Numbers; then againſt 100 on the third Numbers Anſwers a fourth Number on the Segments. Again, Put 100 on the ſecond Numbers, to the ſaid fourth Number on the firſt Numbers; then againſt the whole Content on the ſecond Numbers, Anſwers the wet or dry gallons on the firſt Numbers.

The Bung 28.3 inches, when full contains 114 gallons if 19 inches be Wet, I would know the Wet and Dry Gallons?

Put 28.3 inches on the ſecond Numbers, to 19 inches wet on the firſt Numbers: Then againſt 100 on the third Numbers, Anſwers 73.5 a fourth Number on the Segments. Again, Put 100 on the ſecond Numbers, to 73.5 on the firſt Numbers; then againſt 114 gallons on the ſecond Numbers, Anſwers 83.5 the remaining Liquor on the firſt Numbers. Put 28.3 inches on the ſecond Numbers, to 9.3 inches dry on the firſt Number, then againſt 100 on the third Numbers, Anſwers 27 on the Segments. Again, Put 100 on the ſecond Numbers to the ſaid 27 on the firſt Numbers; then againſt 114 gallons on the ſecond Numbers is 30.5 gallons, the dry gallons on the firſt Numbers.

To find the Content of the lower Fruſtum of a Conoid having an Elliptical Baſe.

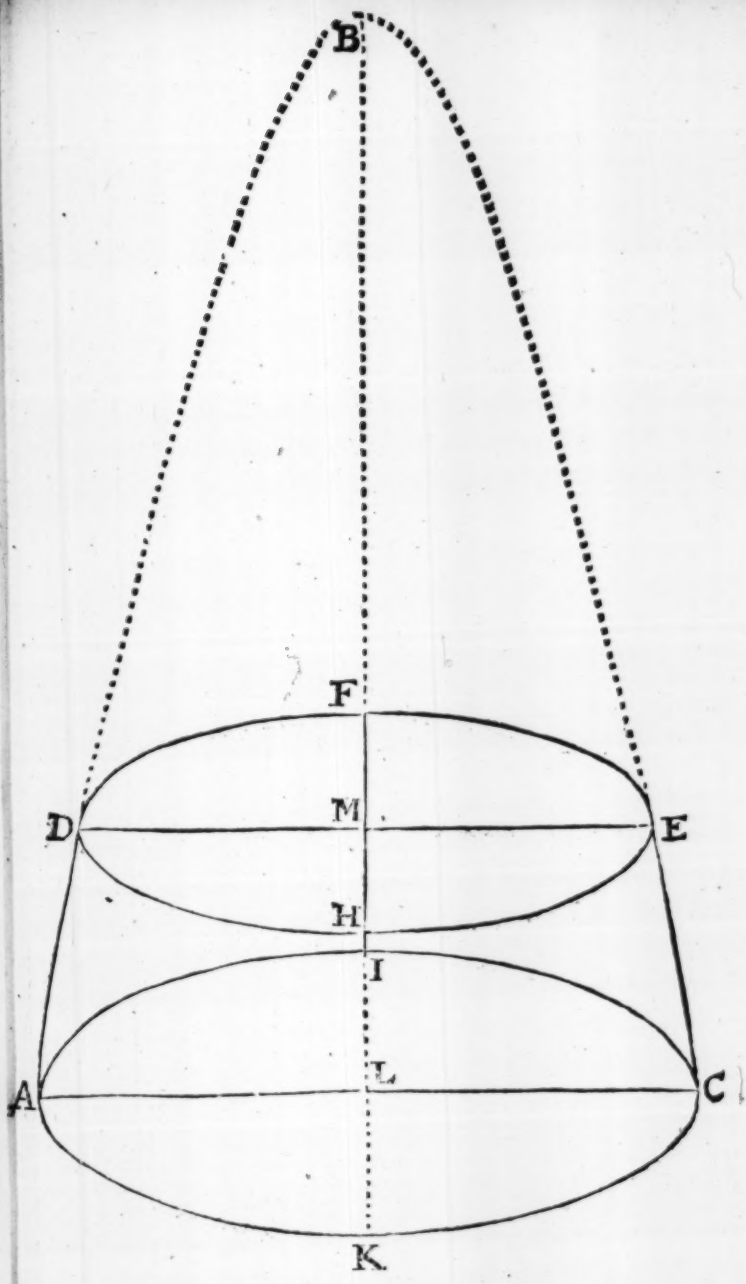
TO the Rectangle of the Top Diameters, add the Rectangle of the Bottom Diameters, Multiply the ſum by the Depth. Then,

Divide by $\left\{\begin{matrix}718\\588\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

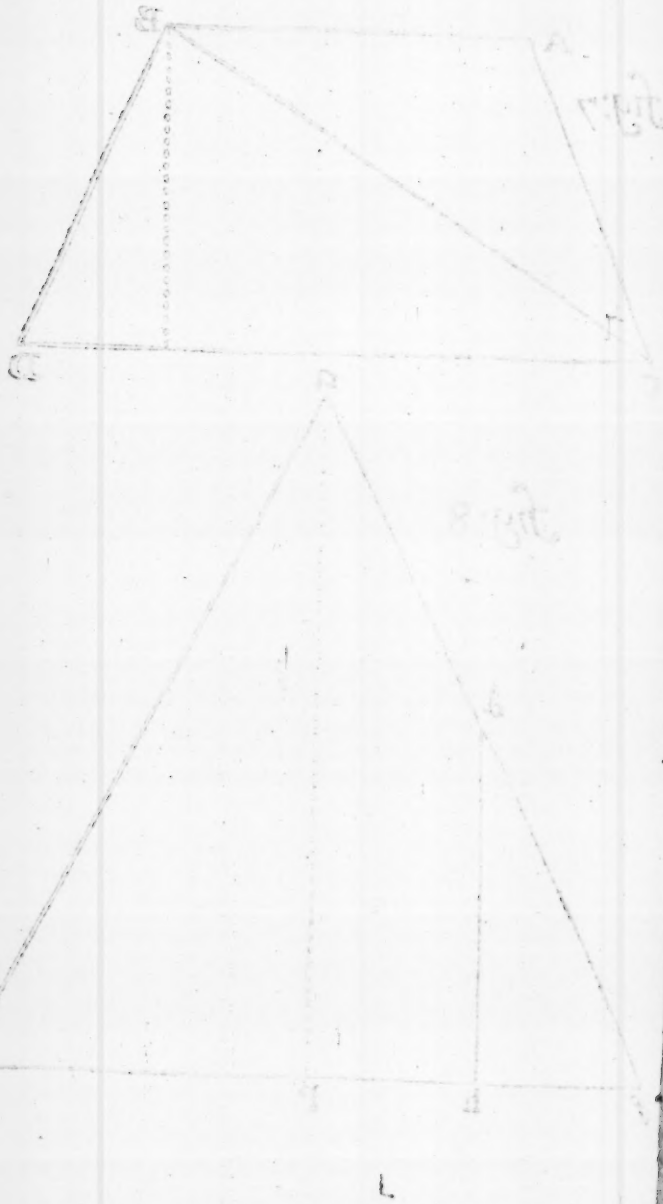
O R,

Multiply by $\left\{\begin{matrix}.0013925\\.0017\end{matrix}\right\}$ for $\left\{\begin{matrix}\text{Beer}\\\text{Wine}\end{matrix}\right\}$ gallons.

Exam-



ABC) is a Conoid having an Elliptical Baſe. BL the Axe.
C is Tranſverſe Diameter of Ellipſis at the bottom. I K is
Conjugate diameter. (ACED) Fruſtum of a Conoid
having an Elliptical Baſe, and belongs to Page 108.
DE)is Tranſv.and(FH)is conjugate diam.of Ellipſis above.



Example.

The Fruſtum of a Conoid having an Elliptical Baſe.

		Inches.	
The	Greateſt Diameter at Top	75	I would know the Content in Beer gallons?
	Leaſt Diameter at Top	50	
	Greateſt Diameter at Bottom	87	
	Leaſt Diameter at Bottom	58	
	Depth	47	

75	87
50	58
3750	696
5046	437
8796	5046
47	
61572	
35184	

718) 413412 (575 Beer gallons.
5441
4152
562

A Cask

A Cask Standing upon one Head, viz. *Its Axe Perpendicular to the Horizon partly Full, and partly Empty; to find the Liquor remaining or drawn forth the Cask, being taken for the Middle Fruſtum of a Parabolick Spindle.*

A Cask	The Bung	29	Contains 85.6 taken for the middle fruſtum of a Parabolick Spindle.
	The Heads	23	
	The Length	42	
	The Wet inches	28	
Diſt. of Liquors ſurface from the Bung		7	

Multiply the ſquare of diſtance of Liquors ſurface from the Bung, by the difference of Bung and Head Diameters; divide the Product by the ſquare of ſemi-length, multiply the ſquare of the Quotient by 0.4 and reſerve the Product, ſubtract the Quotient from the Bung; add the ſquare of the Remainder to twice the ſquare of the Bung, and from the ſum ſubtract the reſerved Product, multiply the Remainder by the diſtance of Liquors ſurface from the Bung, Then divide by 1077 for Beer gallons, or by 882 for Wine gallons, to find the Liquor above or under half Full.

Example.

7	0.66
7	0.66
49	396
6	396
441) 294.0 (0.66	.4356
294.0	0.4
294	.17424 reſerved Product.

29

29
29

261
58

841
2

1682
803

2485
7

..

1077) 17395 (16.15 gall. above half Full.
6625
1630
5530

144

29.0
0.66

28.34
28.34

11336
8502
22672
5668

803.1556

42.8
16.15

Remaining Liquor. 58.25

To

Figure 5.

To find the Content of one or more Slices of a Spheroidal Cask: The Spheroid being Re-Sected by Plains Parallel to the Axe.

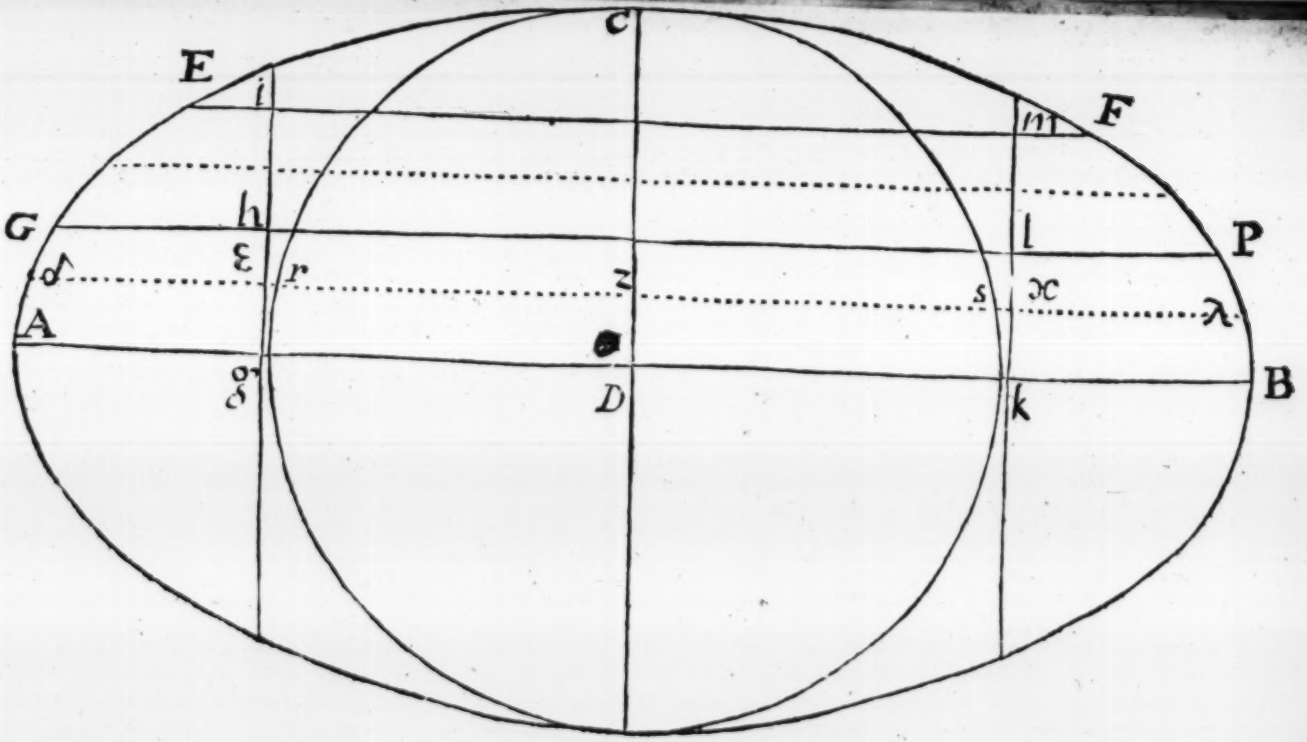
		inches.	
The	Bung	24	I would know the
	Head	20	Content in Wine
	Length	38	gallons?

BY the Bung, Head, and Length find the Axe (A B) of the whole Spheroid, Multiply the Length by the Bung Diameter, divide the Product by the Square Root of the difference of the ſquares of the Bung and Head Diameters; and the Quotient will be (A B) 68.74 inches, the Axe of the whole Spheroid.

Let (CD) the Radius of the Bung Circle be divided into what equal parts you pleaſe (but the more in number the more exact,) then through thoſe Equal parts let plains be drawn at (GP) EF) &c. Parallel to the Axe (AB); I would know the Slices Fruſta's (g h l k) (h l m i) &c.

Firſt find (r s) the Conjugate Diameter, and (ρ λ) the Axe of the Ellipſis in the middle of the firſt Slice. In our Example the Radius (CD) of the Bung Circle is divided into three Equal parts, then each will be (4) and the half of one of theſe will be (z D) (2) the diſtance of the Middle of Ellipſis from (D) the Centre of the Bung from the ſquare of (CD) or (s D) 12, Subtract the ſquare of (D z) 2, the ſquare Root of the Remainder will be (z s,)

11.83


C
E
i
F
m
G
h
l
P
δ
ε
r
n
s
x
λ
A
σ
D
k
B

11.83 and the double will be (r s)23.66 the Conjugate diameter of the Ellipſis. Then as (GR) 24,to (AB) 68.74: So (r s) 23.66, to (ϑ λ) 67.76 the Axe of Ellipſis in middle of the firſt ſlice. From (ϑ λ) 67.76, Subtract (ε ϰ) 38, the half of the Remainder will be (ϑ ε) or (ϰ λ) 14.88. Find the Area 587 of the Circles Segment when the diameter is (ϑ λ) and Verſed Sine (ϰ λ). The Area of this Ellipſis will be found 1259 as in multiplication of decimals.

Then ſay, As 67.76, to 23.66, or as 68.74, to 24: So is 587 the Area of the Circles Segment, to 204 the Area of the Ellipſis's Segment, this doubled and ſubtracted from the Area of the whole Ellipſis, leaves 85.1 the Area of the middle Segment of Ellipſis, which multiplied by 4 the height gives 3404, the Solidity of (g h ſ k) the middle Fruſtum of the firſt ſlice. By the like proceſs you may find any Fruſta's of the other ſlices. 851

If you would Calculate Tables for a Spheroidal Cask Lying, and make the whole Content Unity,

Take ſome regular Veſſel: Then ſay as the Bung diameter of that is to your aſſumed Bung diameter 100; ſo is the Length of that,to the length of yours,and ſo is the head-diameter of that to the head-diameter ofyours. By your Bung, Head and Length find the Spheroids Axe as before: Find alſo the Tranſverſe and Conjugate diameters of the Ellipſis in the middle of every inch, as alſo the Area of the middle Segment of the Ellipſis.By the like method find the Area's of all the other middle Segments & Ellipſis to ; the Content of the Veſſel, the ſum doubled gives the whole Content. Then, As the whole Content to (1): ſo is half the Content more any Number of the ſlices, to the Tabular Numbers above half. This ſubtracted from (1) leaves the Tabular Number under half.

Figure 6.

Let (A H I) *be a Cone: Let this Cone be cut off by a plain* (B G) *Parallel to* (H I) *the ſide of the Cone, I would know the Fruſta's* (A B C) *and* (B H I G)?

Given { A H the diameter ——— = d
L I the Altitude ——— = l
A B the Verſed Sine —— = v
B H the other verſed Sine = q } I would know the Fruſtum ABG?

Let .... $\sqrt{v-q} = g$

Segment of Circle whoſe diameter is (A H) and Verſed Sine (A B) I call (z).

Solidity (A B G) $= \frac{1}{3}l - Z + \frac{4ggg}{5d}$

Segment of the Circle whoſe Diameter is (A H) and Verſed Sine (B H) I call (s).

Solidity (B H I G) $= \frac{1}{3}l - s \times \frac{4ggg}{5d}$

Fig.

4

Figure 7.

Let (ABDC) *be the Fruſtum of a Cone cut Parallel to the Baſe: Let this Fruſtum be Re-Sected by an Oblique plain as* (CB), *I would know the Fruſta's* (ABC) *or* (DCB)?

$$\text{Let} \begin{cases} AB = b \\ CD = d \\ BE = p \end{cases}$$

The Leſſer Fruſtum $ABC = \frac{2dd + db + bb}{dd + bb} - bbp - 0.2618$

Greater Fruſtum $(CBD) = \frac{ddd + bb}{dd + bb} - ddp - 0.2618.$

Figure 8.

Let a Cone as (b c a) *be cut off by a plain* (h d) *Parallel to the Axe* (a p): *I would know the fruſta's* (b h d) *and* (h c a d).

$$\text{Let} \begin{cases} (b\,c) \text{ the diameter of the Baſe} = B \\ (h\,p) \text{ the Co-ſine} \text{ ——} = C \\ (a\,p) \text{ the Axe of the Cone} = P \end{cases}$$

Let —— $\sqrt{\frac{1}{4}BB + CC} = (G)$

Let Log. of — $\frac{B \times 2G}{2C}$ taken from the Tab. be called (L.)

Let 4.60517 be called (N.)

Let alſo the Area of Circles Segment whoſe diameter is (b c) and Verſed Sine (b h) be S.

The

$$\left.\begin{array}{l}\text{The Solidity}\\ \text{of the Fru-}\\ \text{ſtum (bhd.)}\end{array}\right\} = S + CG \times \frac{CCCLN}{B} - \frac{1}{3} P$$

If Z be the Area of the Segment of the Circle when the diameter is (b c) and Verſed Sine (h c).

$$\left.\begin{array}{l}\text{The Solidity of}\\ \text{the greater Fru-}\\ \text{ſtum (h c a d).}\end{array}\right\} = Z \times CG + \frac{CCCLN}{B} - \frac{1}{3} P$$

FINIS.

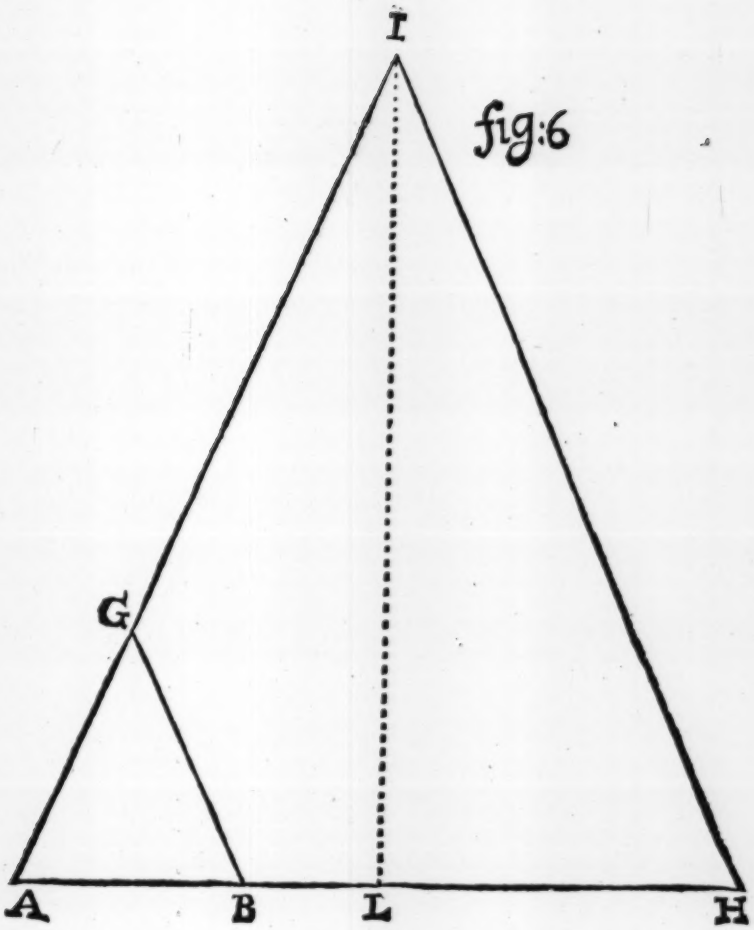


fig:6

fig: 7

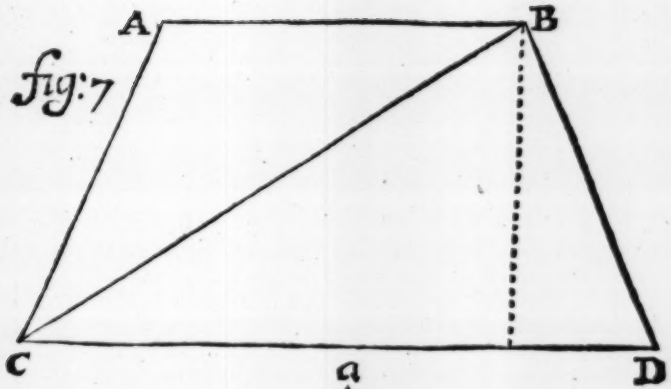
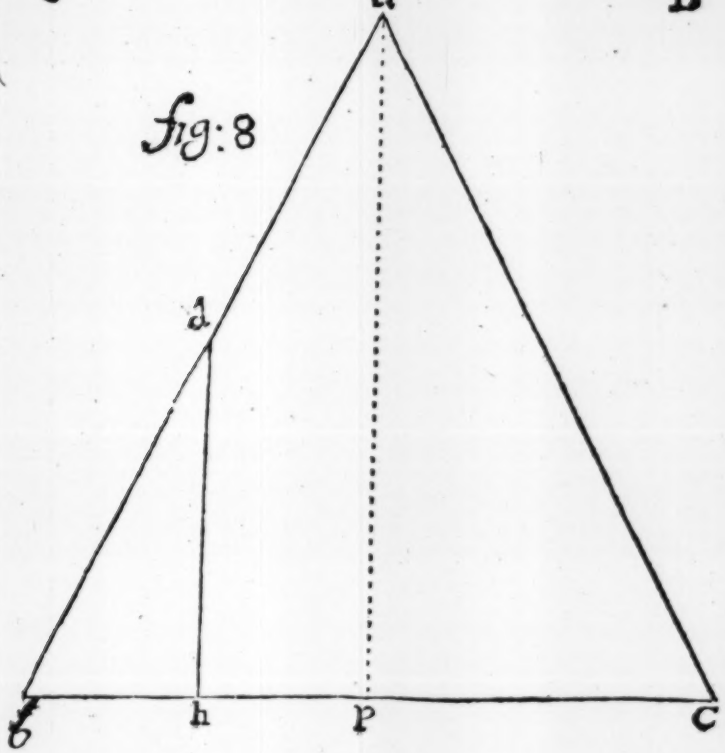



fig: 8